Rethinking our roads

NVF Road design 17.2.2025

Elina Kalliala
Global Sustainability Director
Ramboll Transport

RAMBØLL

Bright ideas.
Sustainable change.

Ramboll in brief

- Independent architecture, engineering, and consultancy company
- Creating sustainable solutions across energy, real estate, transport, water, waste, industry, finance, technology, healthcare and public sectors.
- Founded 1945 in Denmark
- Owned by Rambøll Fonden – The Ramboll Foundation providing long term stability

>35

Countries covered by global office network

>18,000

Experts

2.3 Bn

Global revenue, in 2023

across all markets

Our Strategy 2022-2025

The Partner for Sustainable Change

Our mission is to create sustainable societies where nature and people flourish.

SCIENCE BASED TARGETS
DRIVING AMBITIOUS CORPORATE CLIMATE ACTION

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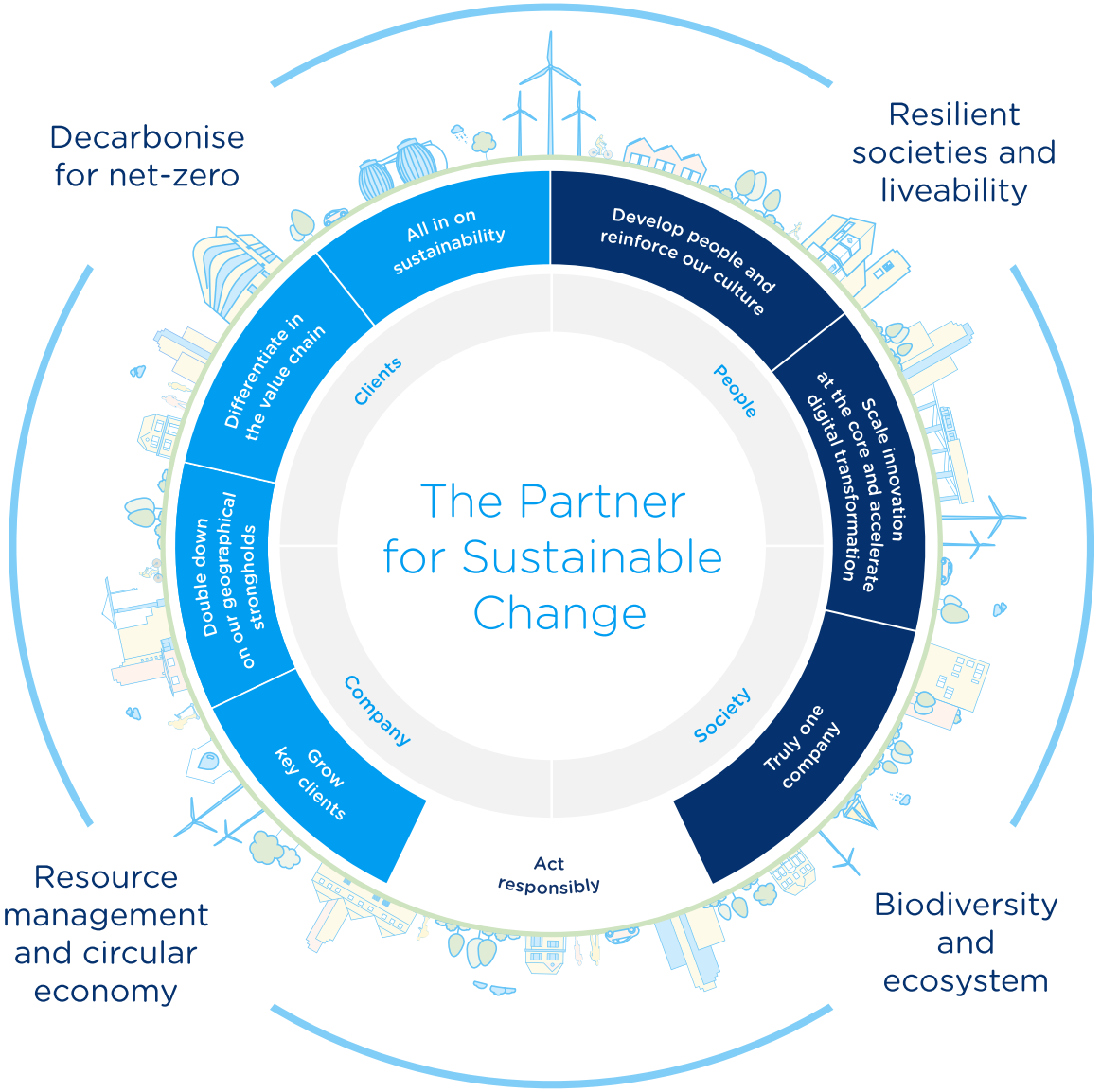
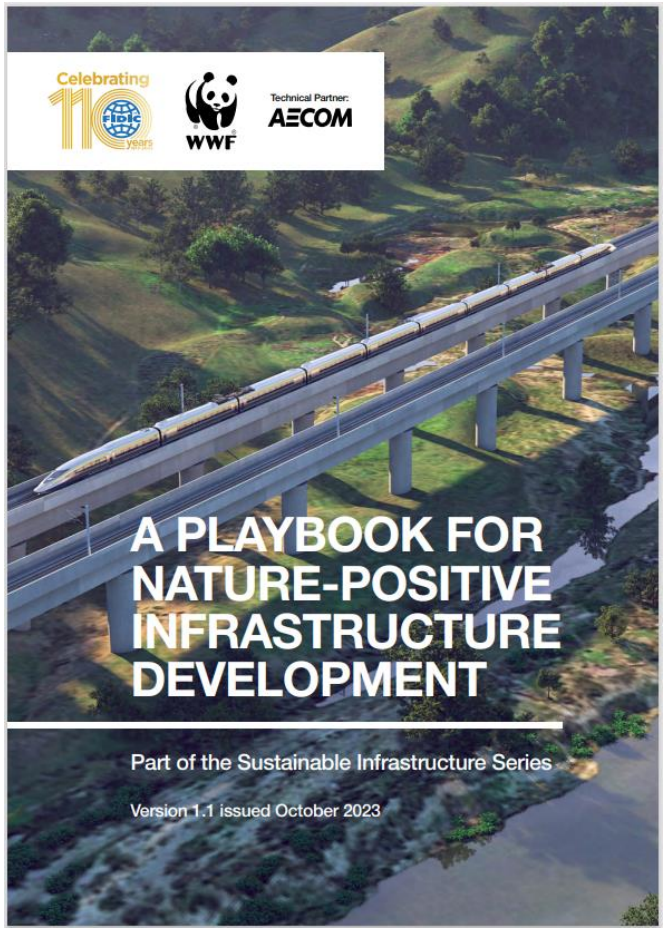


Global support from our industry



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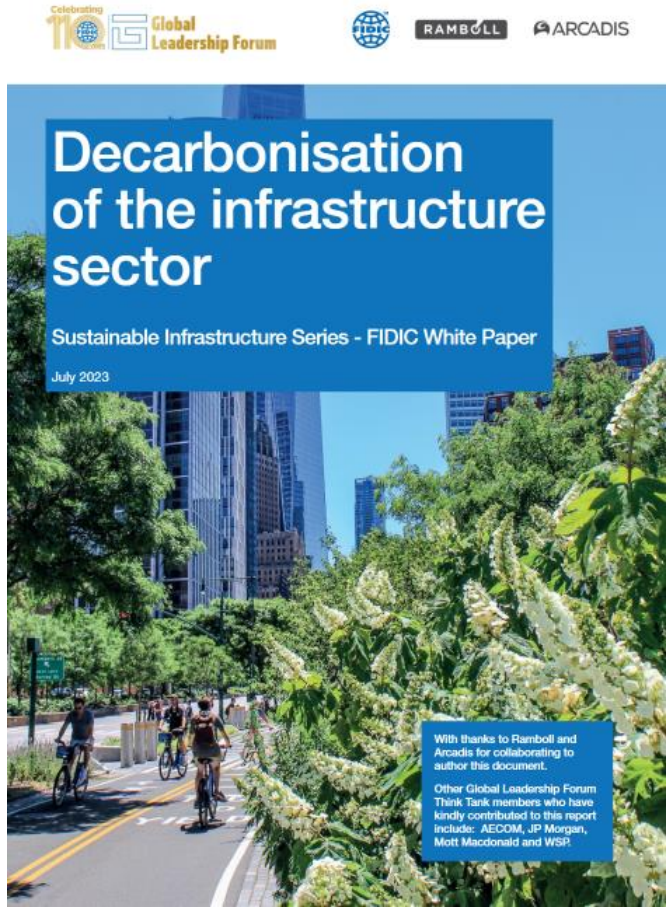


Decarbonisation of the infrastructure sector by FIDIC - Issuu

FIDIC™

Carbon Collaboration Initiative

Our ambition is to support our members to increase their carbon management maturity through providing advise and building on existing guidance and tools.

Draft Carbon Management Framework launched in April 2025

FIDIC Carbon Collaboration Initiative by FIDIC - Issuu

The storyline

Rethinking infrastructure – why and how?

Case examples

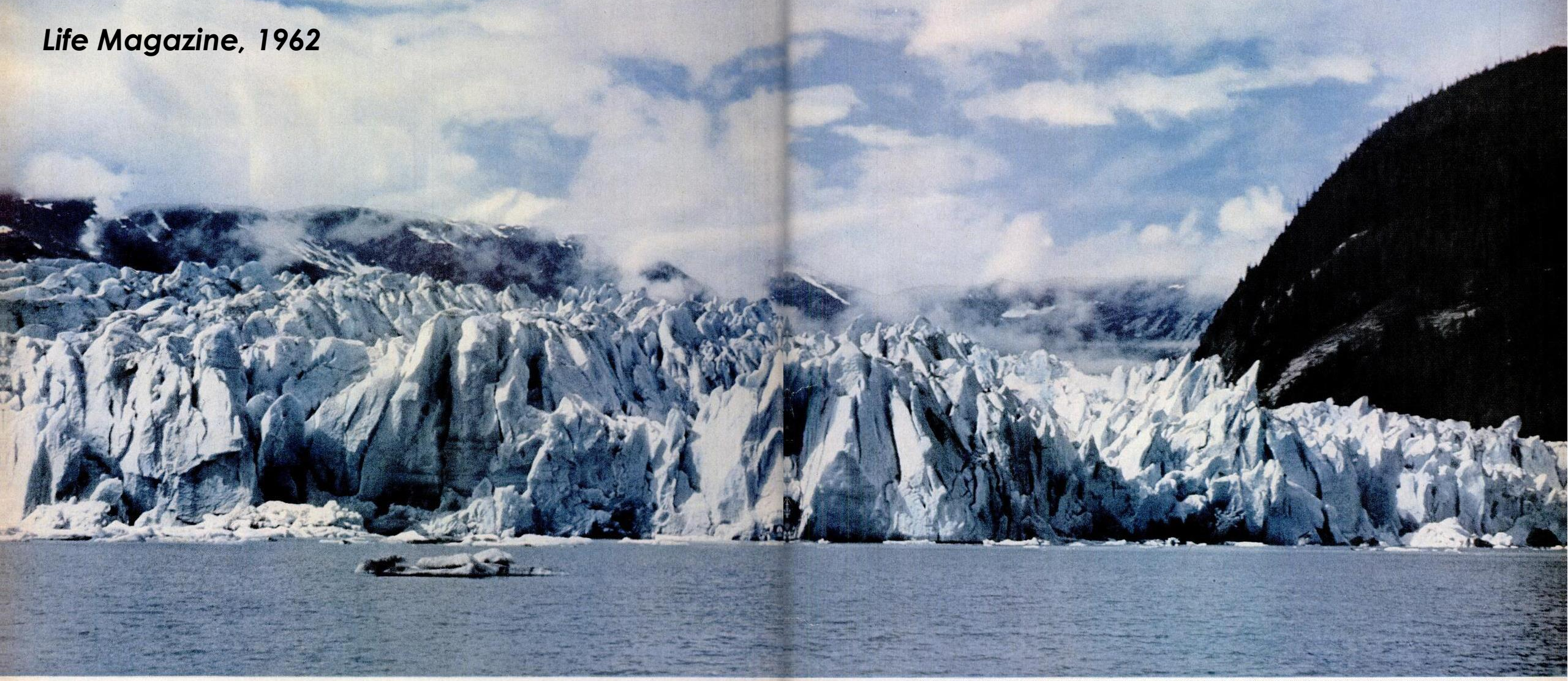
Discussion

Global polycrisis & the role of infrastructure today and in the future

Our infrastructure has typically been built for only one purpose and for a climate that no longer exists.

Image: Lahti, Finland. YLE

Life Magazine, 1962



TAKU GLACIER, ALASKA, IS A RIVER OF ICE STRETCHING 270 SQUARE MILES. YET THE PETROLEUM ENERGY HUMBLE SUPPLIES AMERICA COULD MELT IT AT THE RATE OF 7 MILLION TONS A DAY!

EACH DAY HUMBLE SUPPLIES ENOUGH *ENERGY* TO MELT 7 MILLION TONS OF GLACIER!

This giant glacier has remained unmelted for centuries. Yet, the petroleum energy Humble supplies—if converted into heat—could melt it at the rate of 80 tons each second! To meet the nation's growing needs for energy, Humble has applied science to nature's resources to become America's Leading Energy Company. Working wonders with oil through research, Humble provides energy in many forms—to help heat our homes, power our transportation, and to furnish industry with a great variety of versatile chemicals. Stop at a Humble station for new Enco Extra gasoline, and see why the "Happy Motoring"® Sign is the World's First Choice!

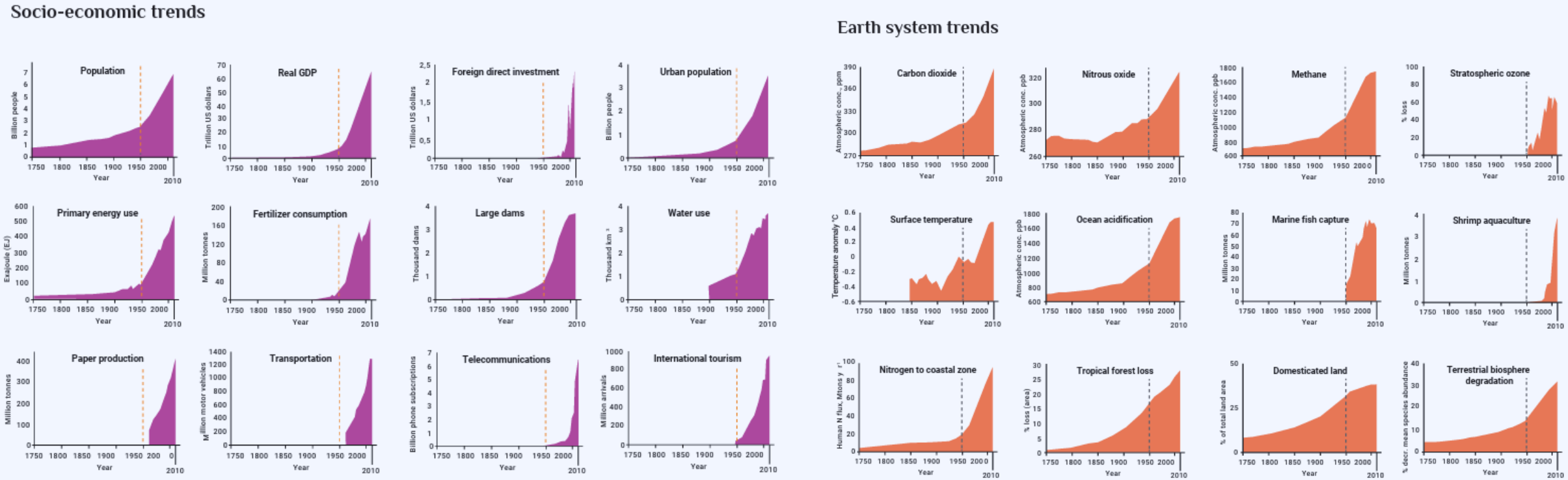
HUMBLE
OIL & REFINING COMPANY
America's Leading ENergy COmpany

ENCO

R1

R2

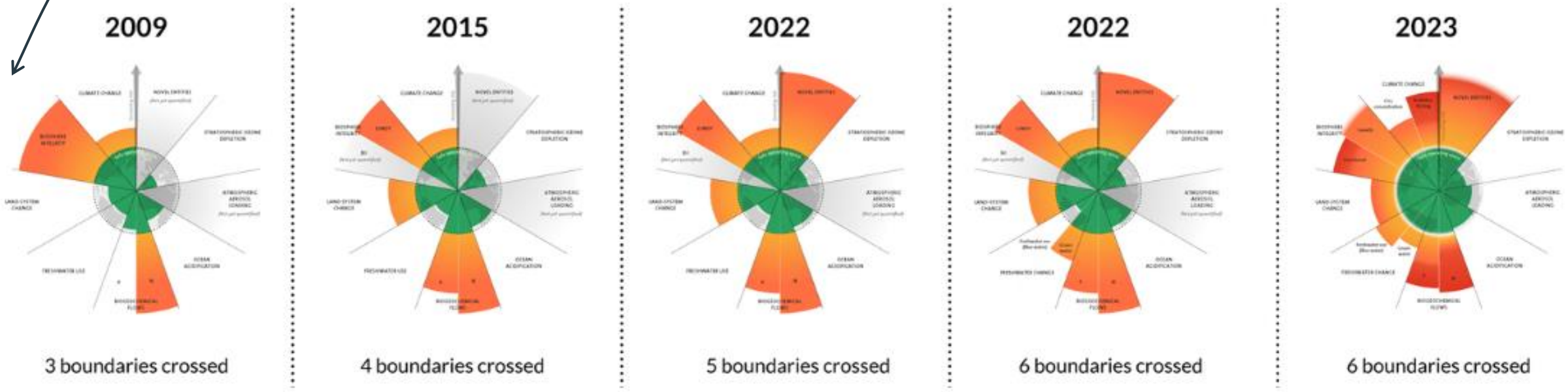
Human ”growth” causes negative impacts to Earth System



The socio-economic and Earth system trends of ‘Great Acceleration’. Source: Steffen et al. (2015b).

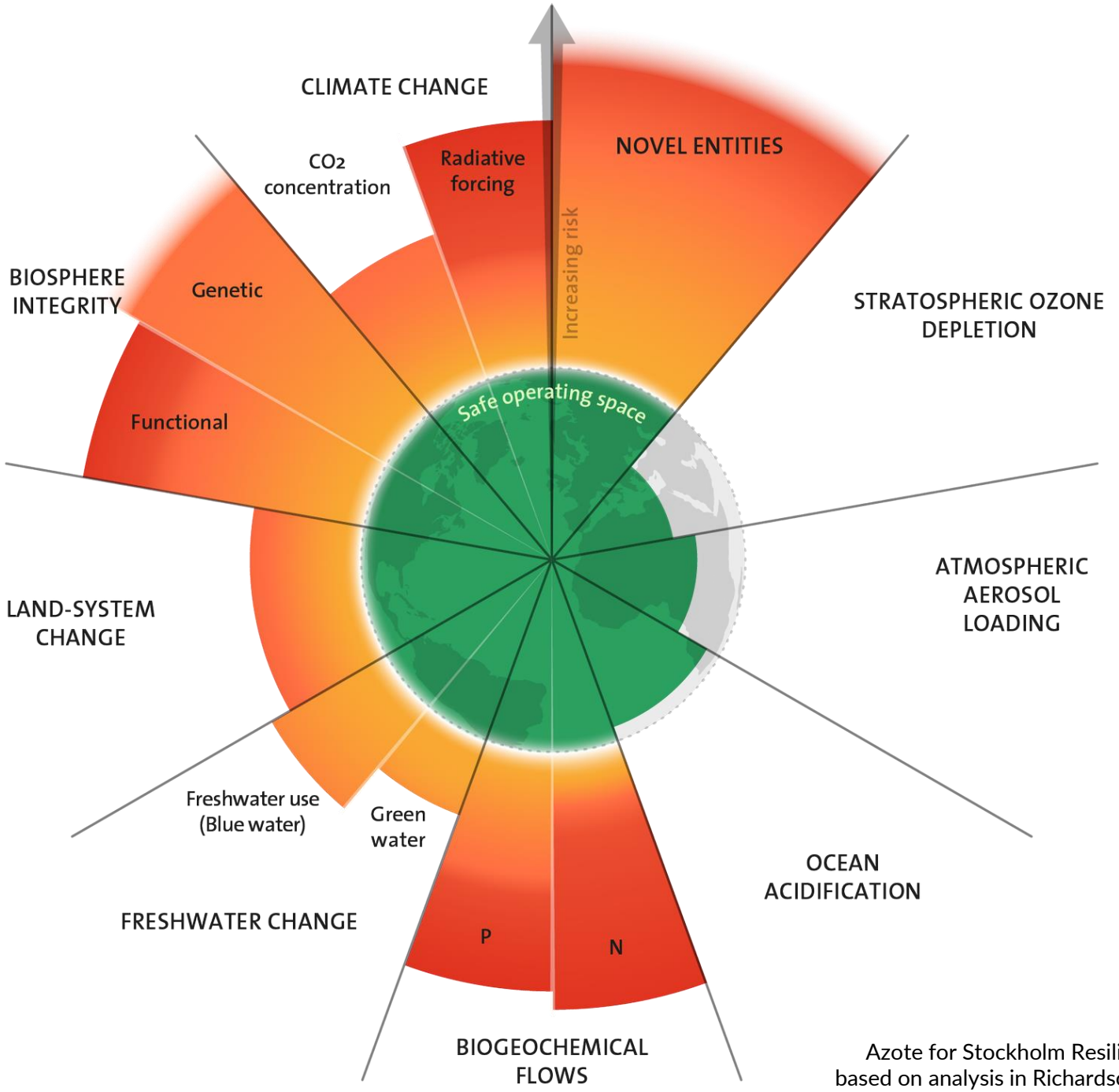
9 planetary boundaries

COP-1, April 1995, Berlin



Azote for Stockholm Resilience Centre,
based on analysis in Richardson et al 2023

How to get back to the safe operating space?



Azote for Stockholm Resilience Centre, based on analysis in Richardson et al 2023

The role of infrastructure in global settings

Social impacts

- Enabling goods and people movement
- Creating also negative social impacts

Emission impacts of infrastructure, amount of embodied carbon

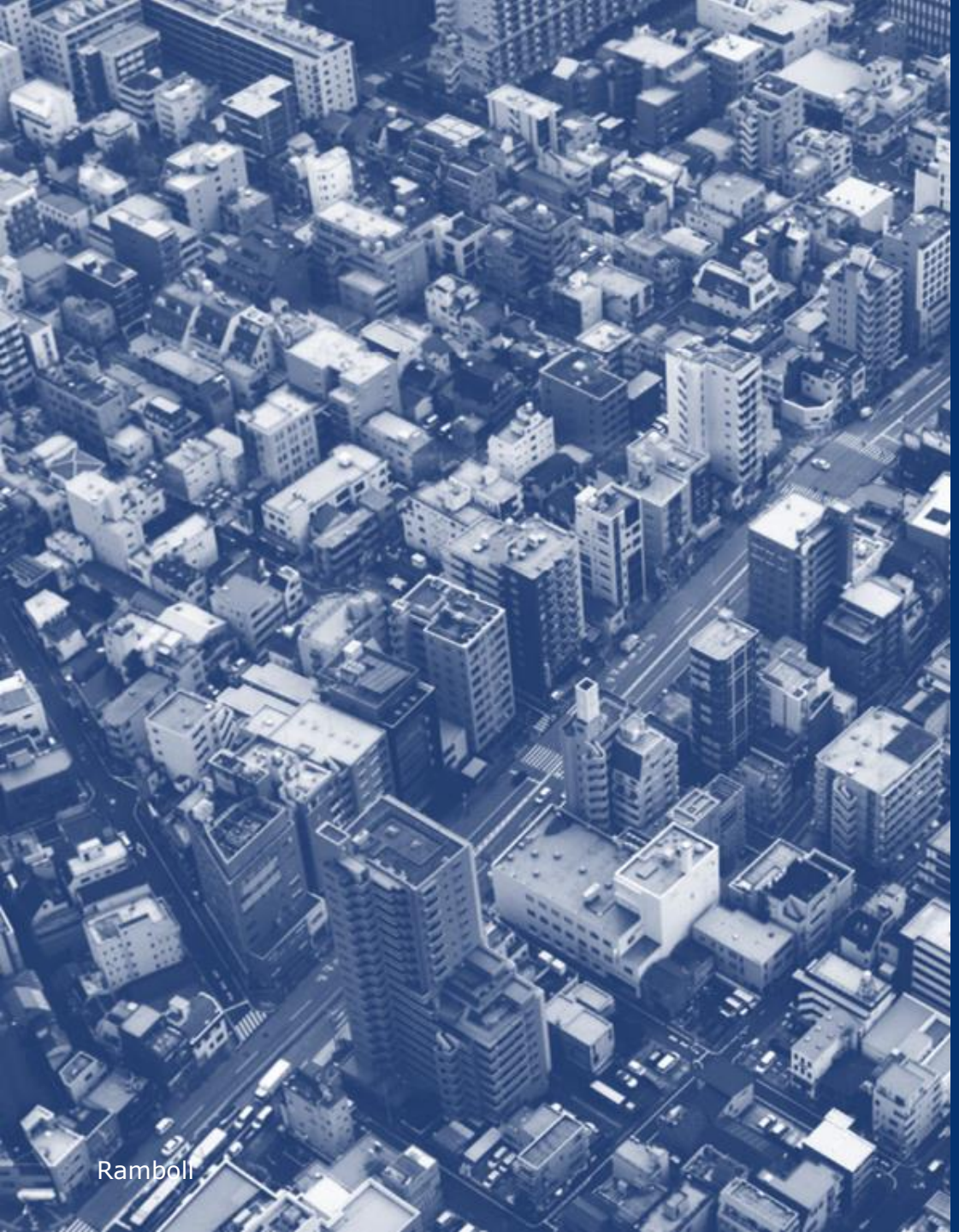
- All infrastructure sectors together are responsible for 79% of the global emissions [Source. UNEP 2021].
- Transport infrastructure is responsible of 16% [Source. UNEP 2021].

Impacts on biodiversity

- 14.6% of the world's land area has been modified by humans, [Source. WEF].
- 90% of biodiversity loss is linked to use or natural resources [Source. UN 2021].

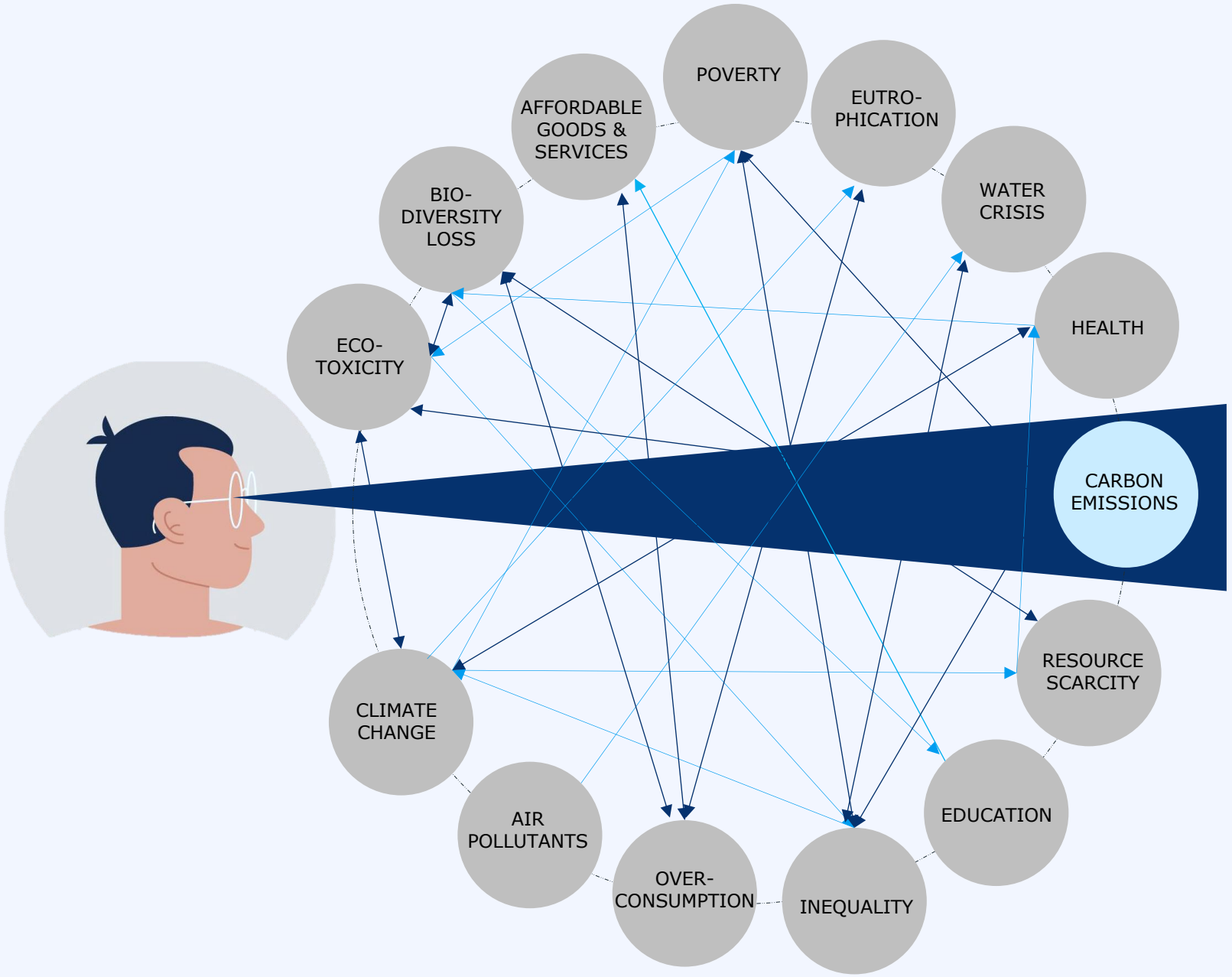
Impacts on natural resources

- Infrastructure consumes more than 50% of the world’s materials and the amount is growing [Source. Global Infrastructure Hub]



> In many ways, the environmental crisis is a design crisis.
>
> It is a consequence of how things are made, buildings are constructed, and landscapes are used.

Van der Ryn & Cowan, 2007



Sustainability transition

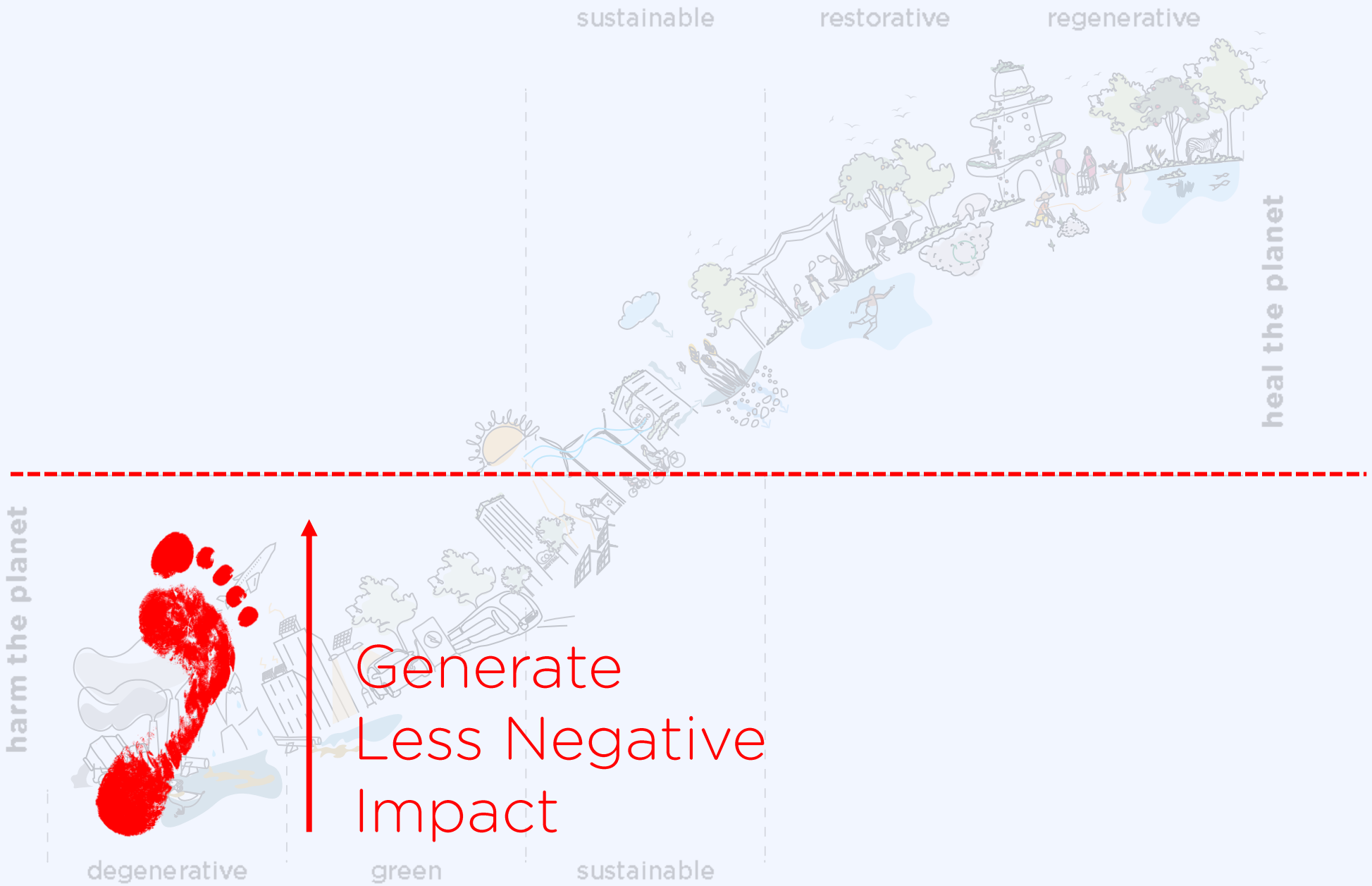
We cannot solve our problems with the same thinking we used when we created them.

- Albert Einstein

Rethinking infrastructure.

Are we successful in the right things?

The New Paradigm - We are Nature


sustainable
restorative
regenerative
heal the planet
harm the planet
degenerative
green
sustainable
Generate
Less Negative
Impact

sustainable restorative regenerative

Generate
Positive Impacts
Now and beyond

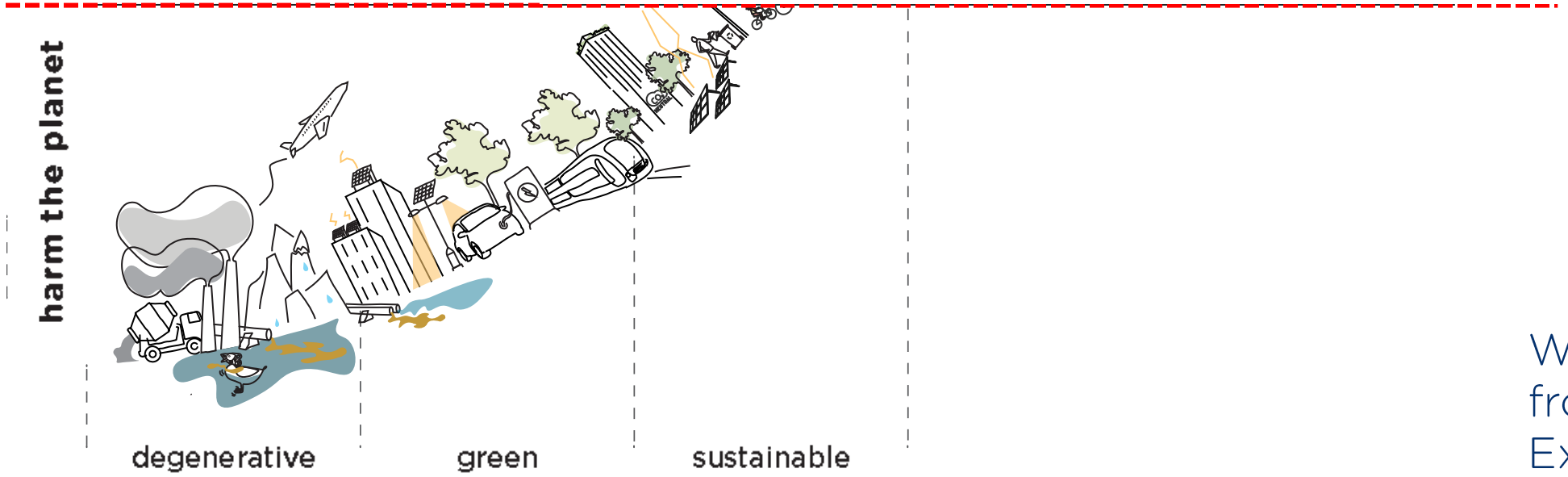
heal the planet

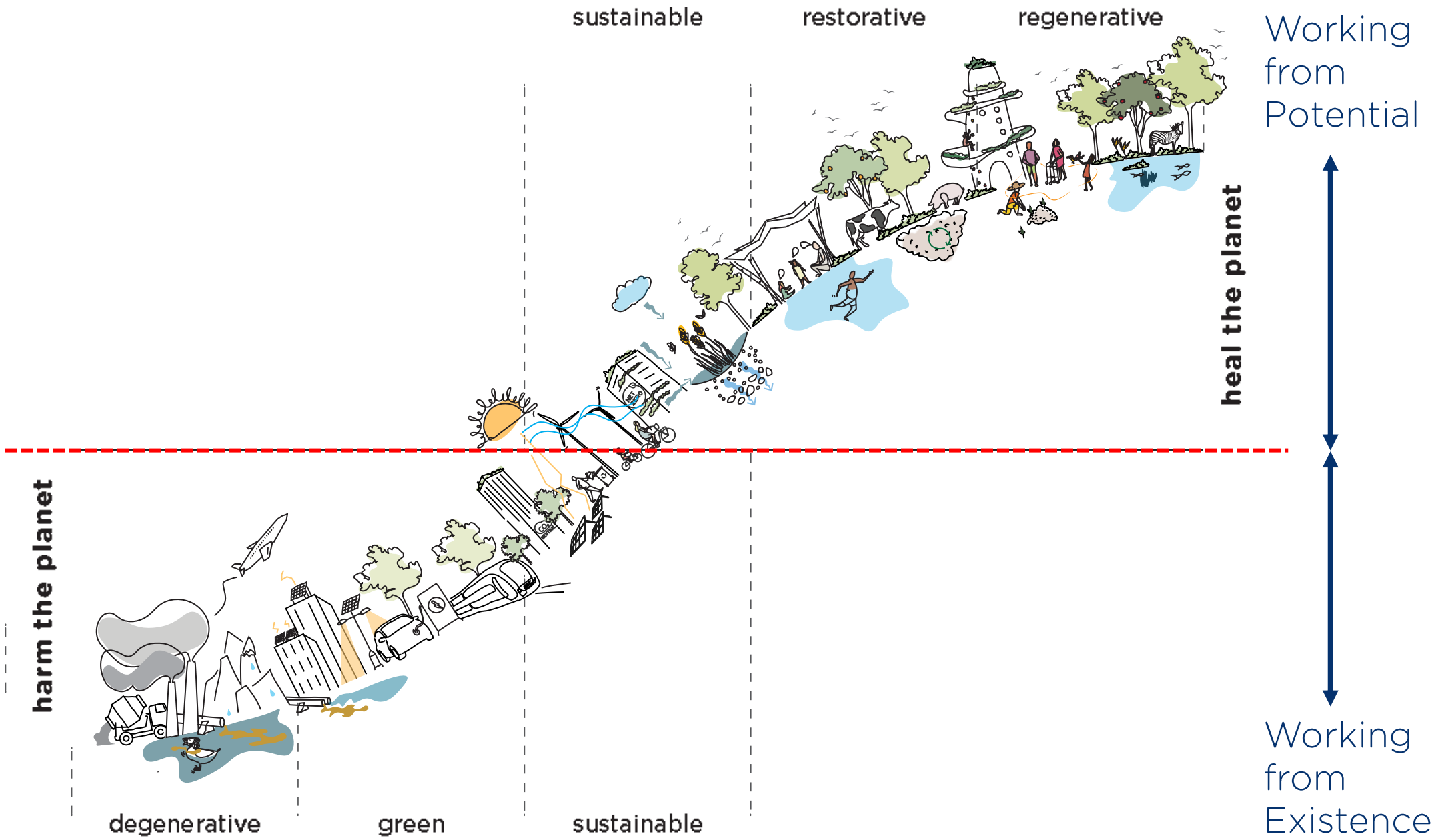
harm the planet

Generate
Less Negative
Impact

degenerative green sustainable

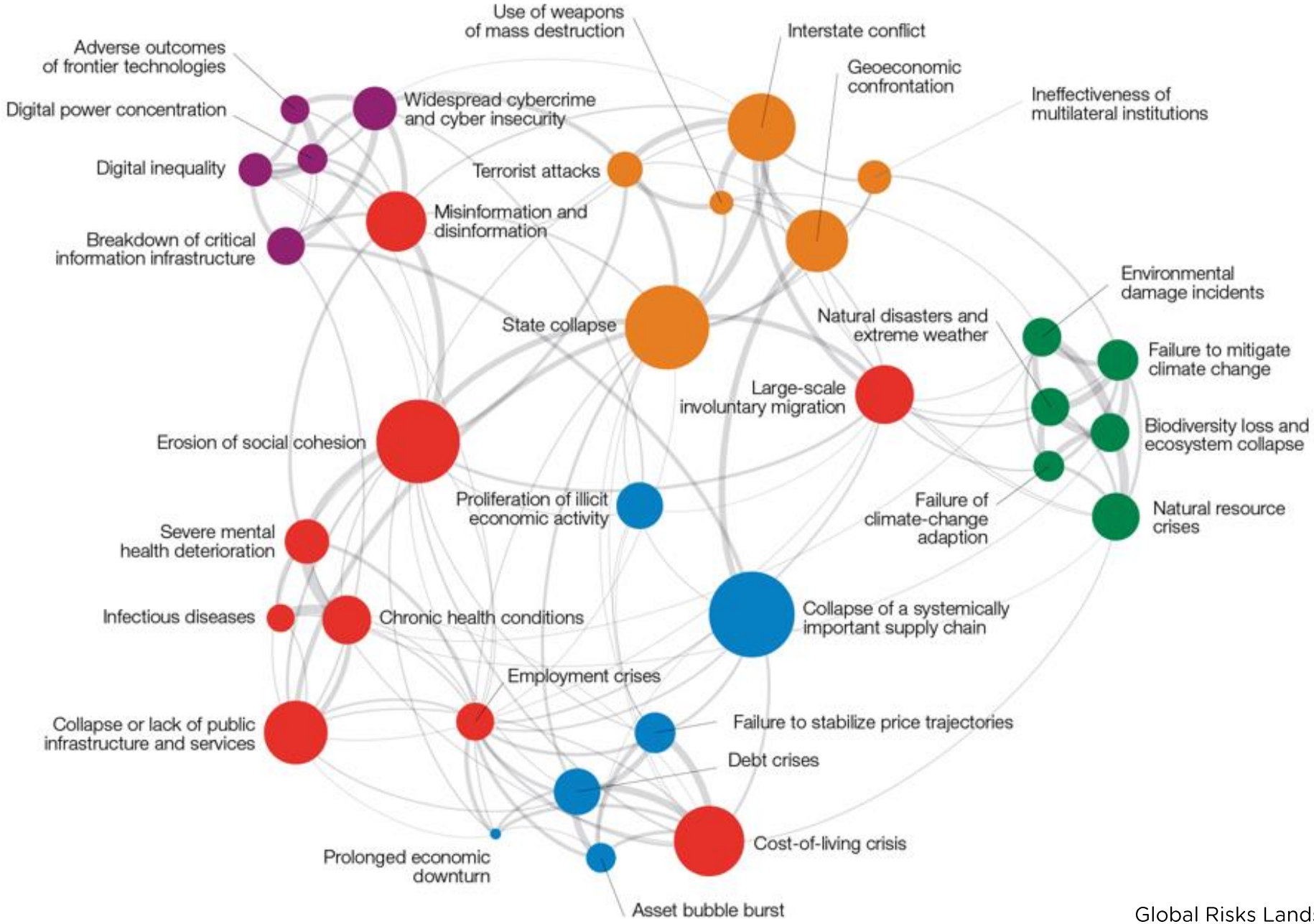
Ramboll


harm the planet
degenerative
green
sustainable
Working from Existence


sustainable
restorative
regenerative
Working from Potential
heal the planet
harm the planet
Working from Existence
degenerative
green
sustainable

It’s not just more of the same

Partnering with the nature
…as part of nature



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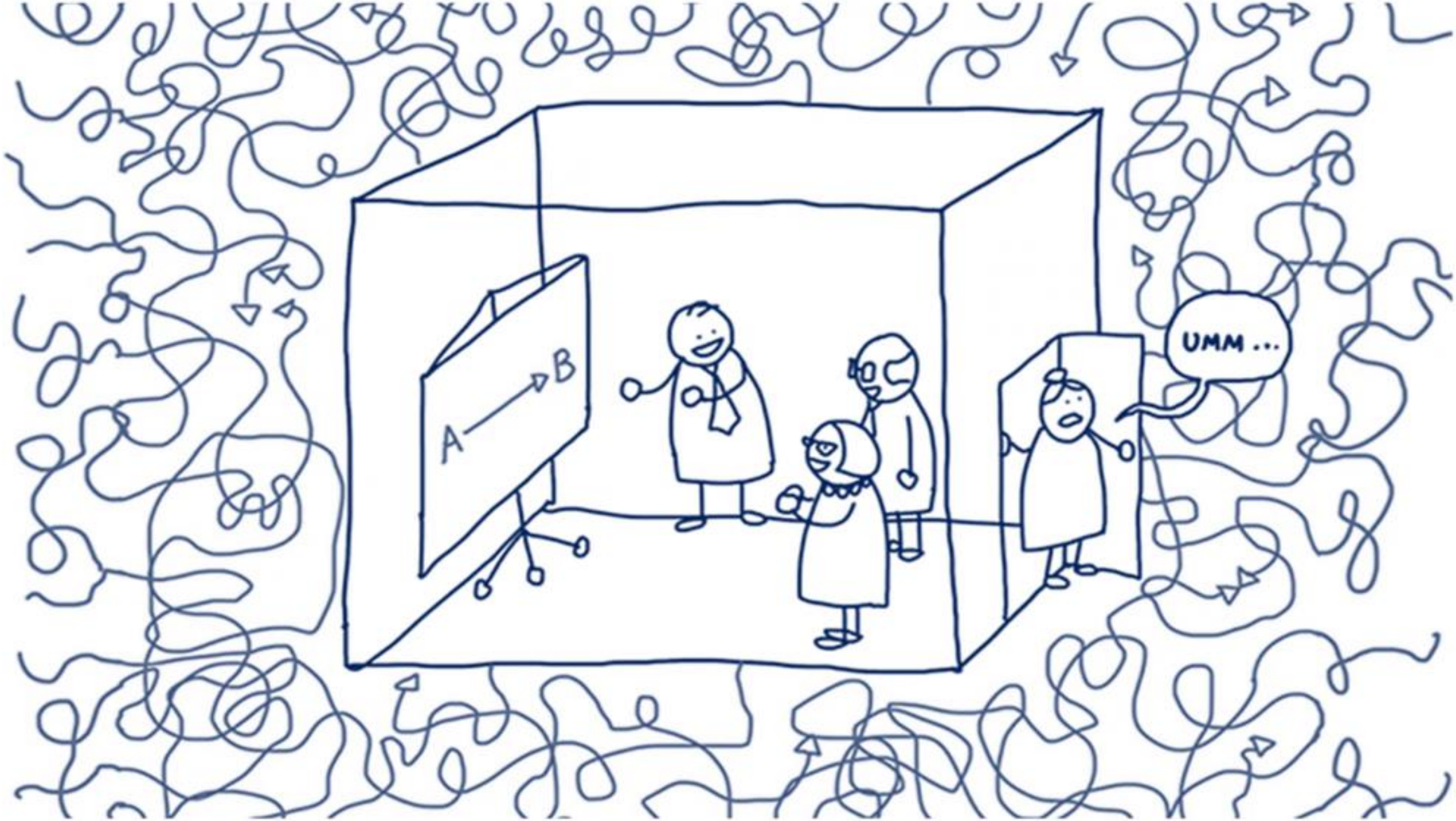
Global Risks Landscape
World Economic Forum 2023

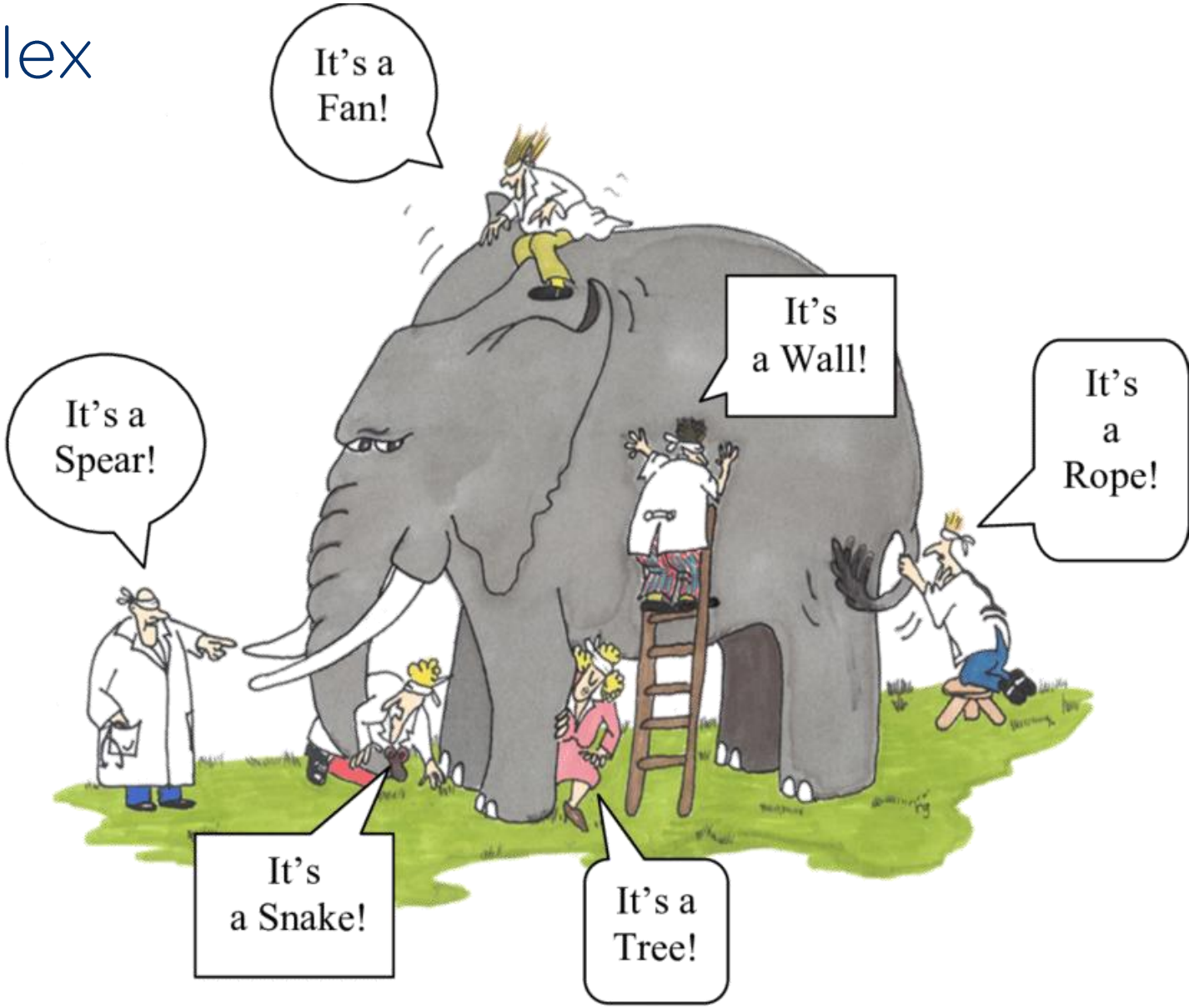


Source: https://www.businessillustrator.com/tag/complexity/

Solving the complex challenges

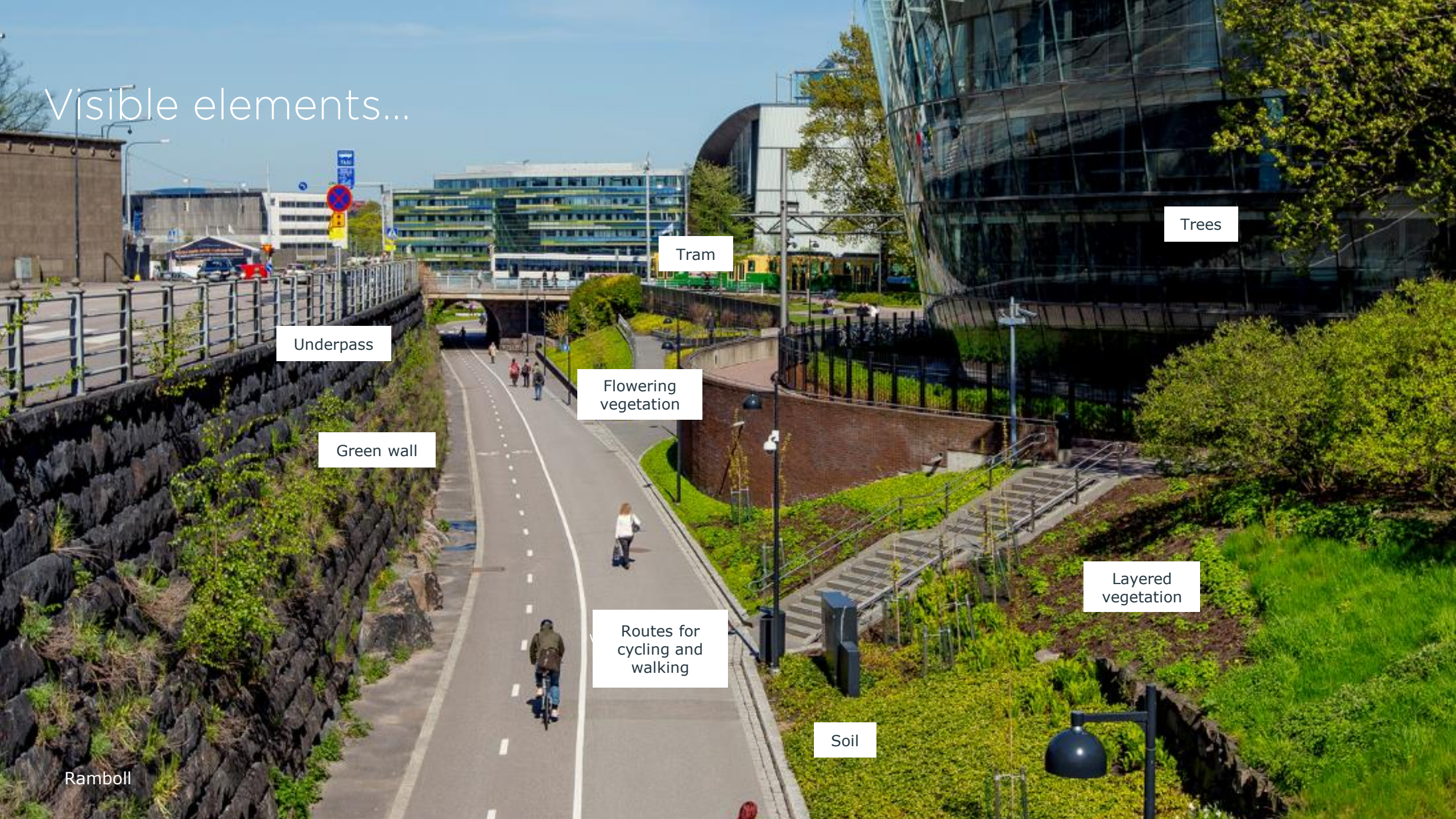
Silos vs systems

Curiosity
Courage
Communication
Co-creation
Creativity

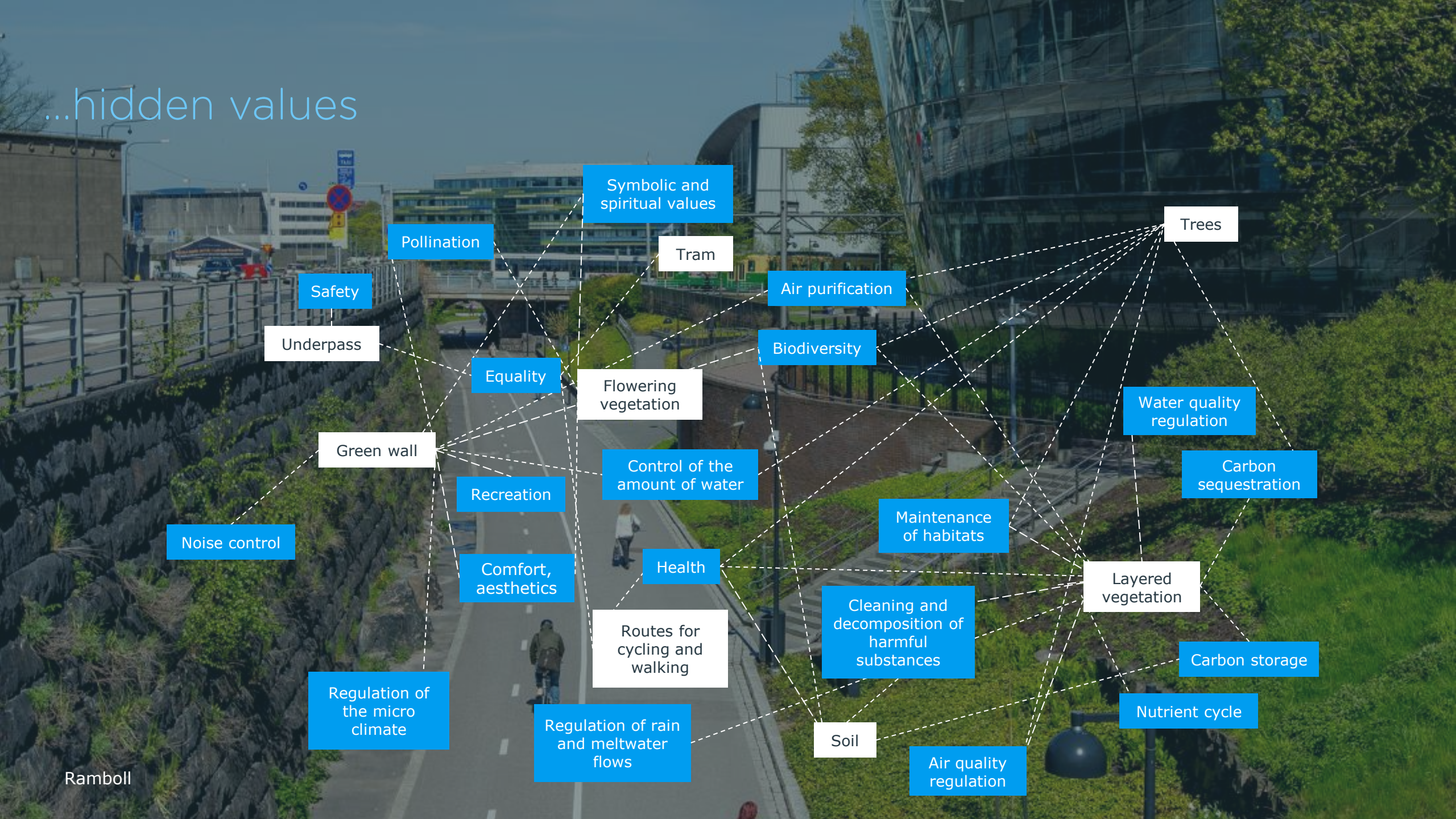


Enterprise Agile Transformation – Are You Able to See Big Elephant? (agilebuddha.com)

Visible elements…



...hidden values



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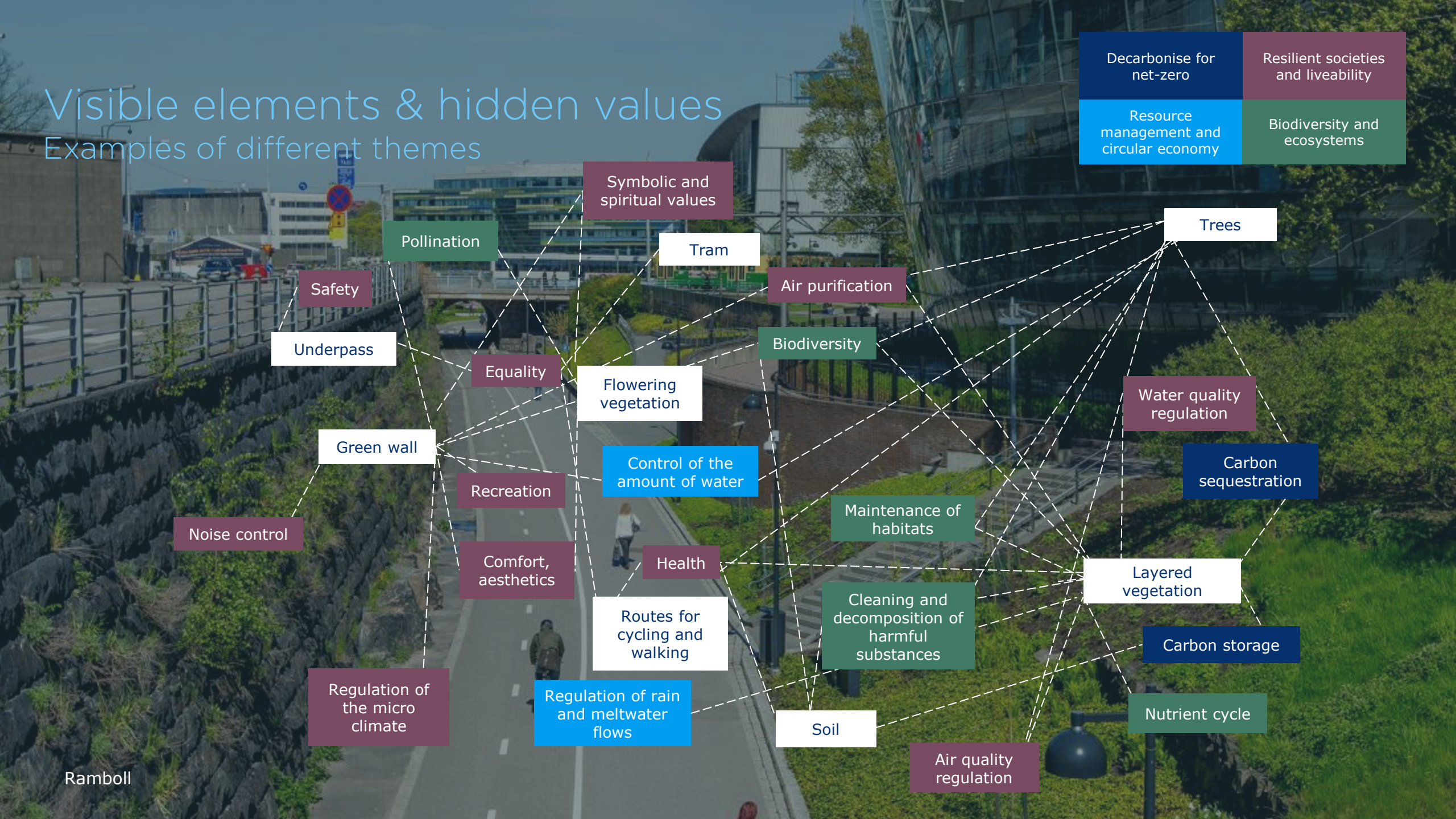
Visible elements & hidden values

Examples of different themes



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FLEXIBILITY AND MULTIFUNCTIONALITY

From everyday liveability & functionality
to extreme events with multiusage & resiliency

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to extreme events with multiusage & resiliency

To be successful in the right things...

...we need to identify the right questions

Identifying the potential

What is a bridge/highway/street...?

How does it add value to the systems that it's connected to?

How can it be part and add value to the energy systems, ecological systems, social systems etc?

Could it clean the water, air, soil?

Reflections and notes

Think and write down 1 idea or action for you or for your team and for this committee

How could I improve my project, guidelines, strategy, tender documents, collaboration, stakeholder management…?

Multifunctionality as a key goal

Inspiration from different countries & scales

Rethinking the business case and return of investment in infrastructure

Can we afford not to address the multifunctionality and resilience of our infrastructure assets?

Expected average **annual costs of climate-related damage to buildings and infrastructure could rise to between 3 to 20 billion NOK by 2100** without adaptation measures.

- The Norwegian Directorate for Civil Protection (DSB)

Global infrastructure losses could reach up to **$4.2 to $13.8 trillion by 2100**.

-The Intergovernmental Panel on Climate Change (IPCC)

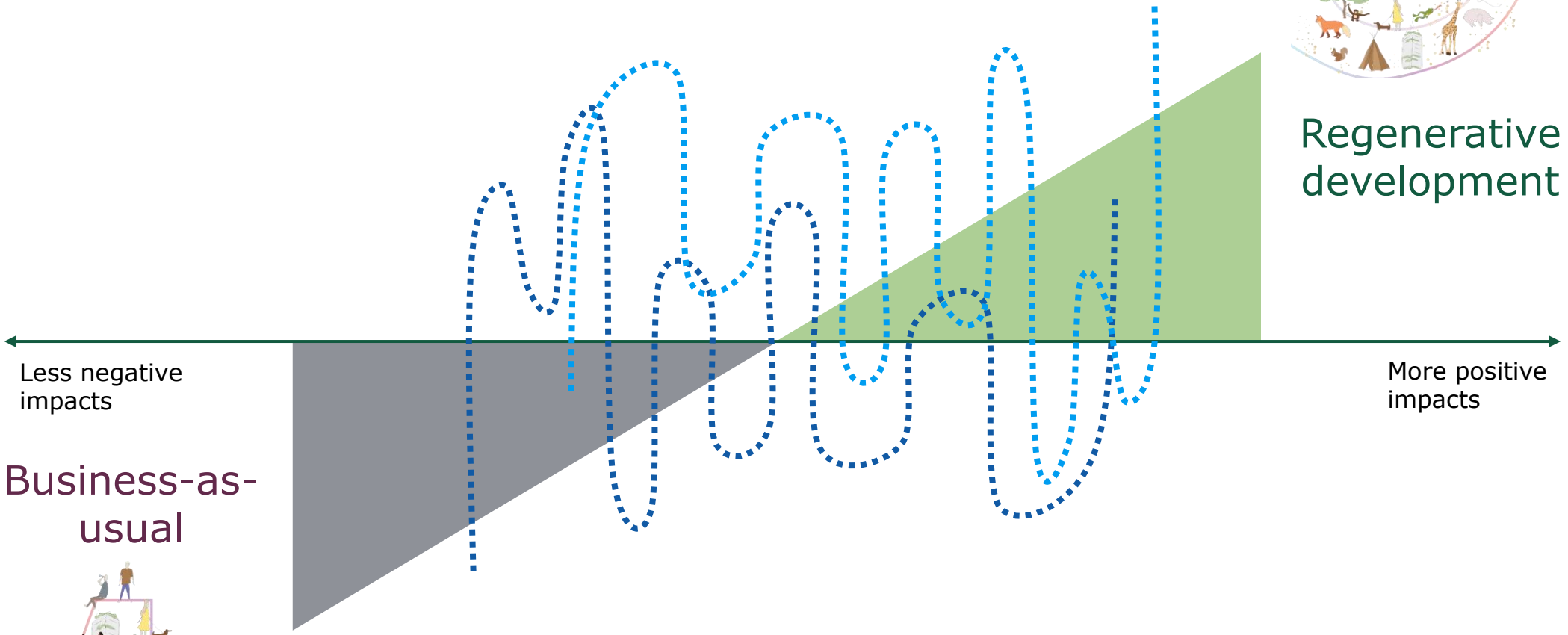
For every $1 invested in a **Blue-Green Infrastructure Network** makes $2.09 in return

- Case New York City

It’s a journey!

- embrace it, set high goals and keep learning and improving!

Regenerative development

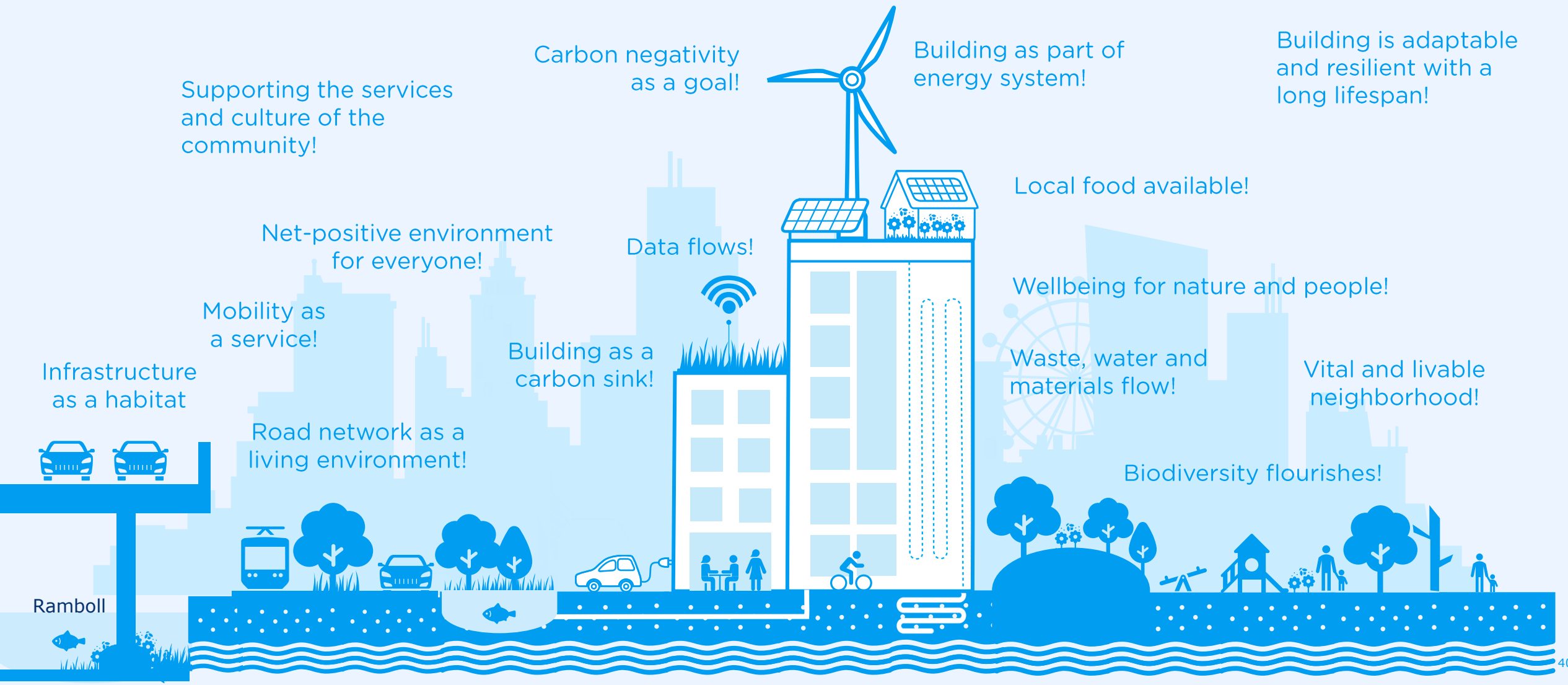


Business-as-usual

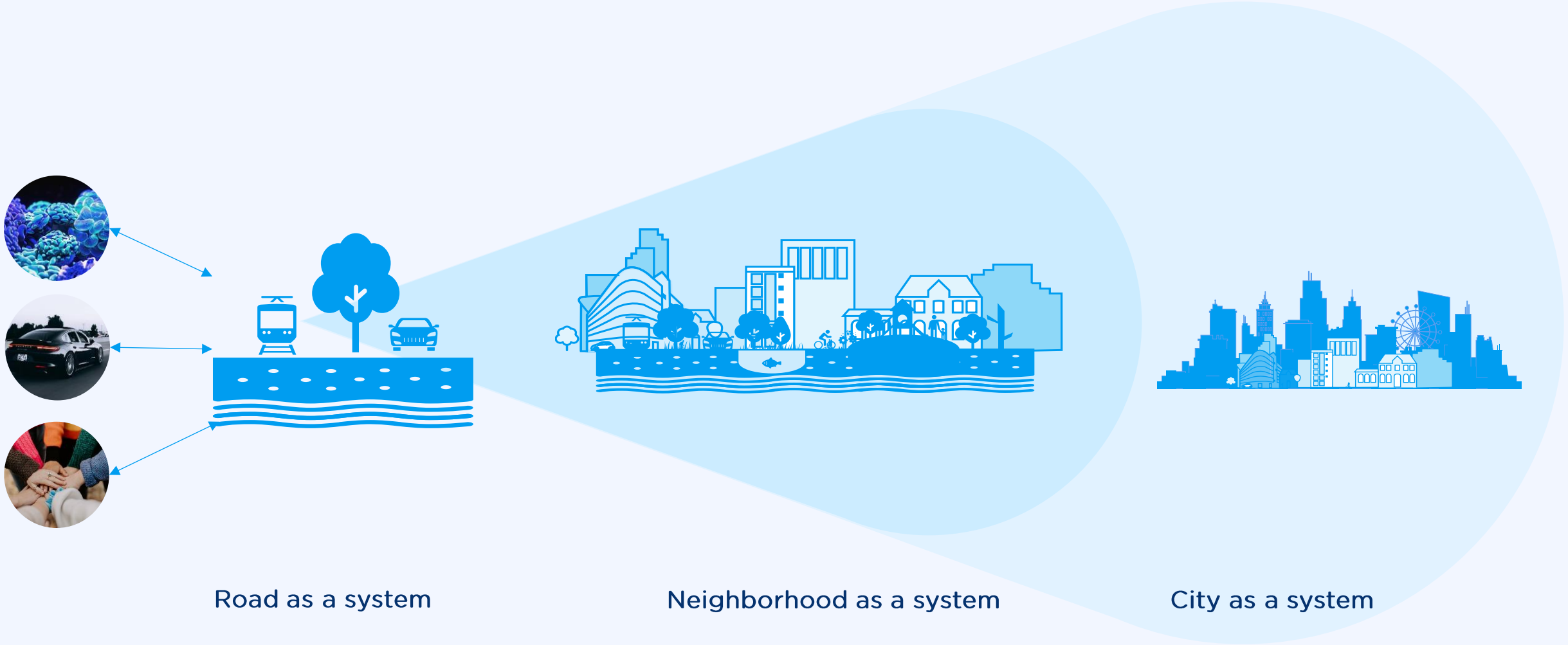
Every project is an opportunity to make the world comprehensively a better place.

We need everyone's imagination, curiosity and courage to re-learn and reshape our industry.

Imagine a city as a living system



Built environment as a living system of systems



Road as a system

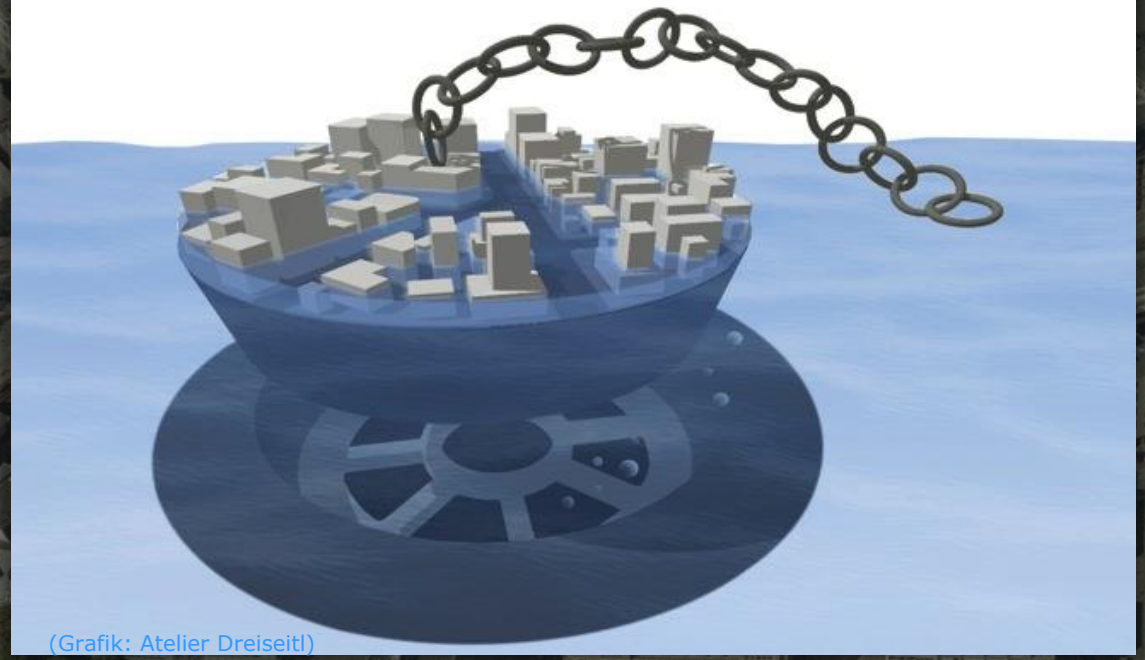
Neighborhood as a system

City as a system

Water as the key ingredient in rebalancing our planet

INTEGRATION OF STORMWATER MANAGEMENT

STATUS:



(Grafik: Atelier Dreiseitl)

END OF PIPE SOLUTION

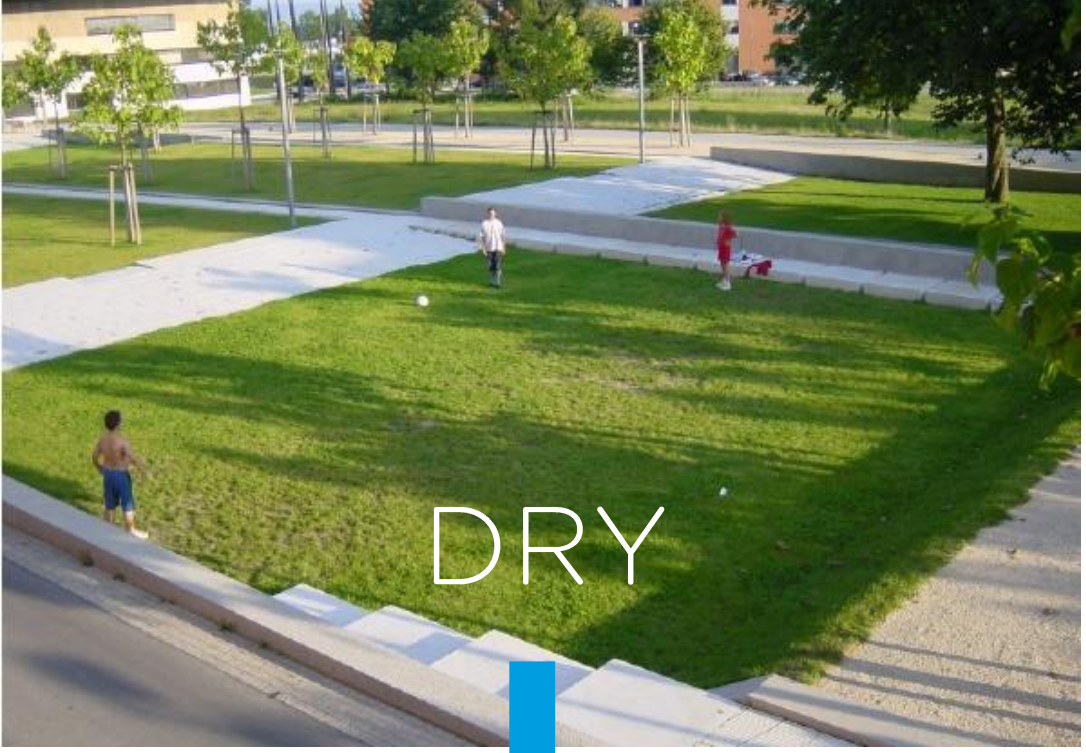
ELIMINATION OF WATER

GOAL:

(Grafik: Atelier Dreiseitl)

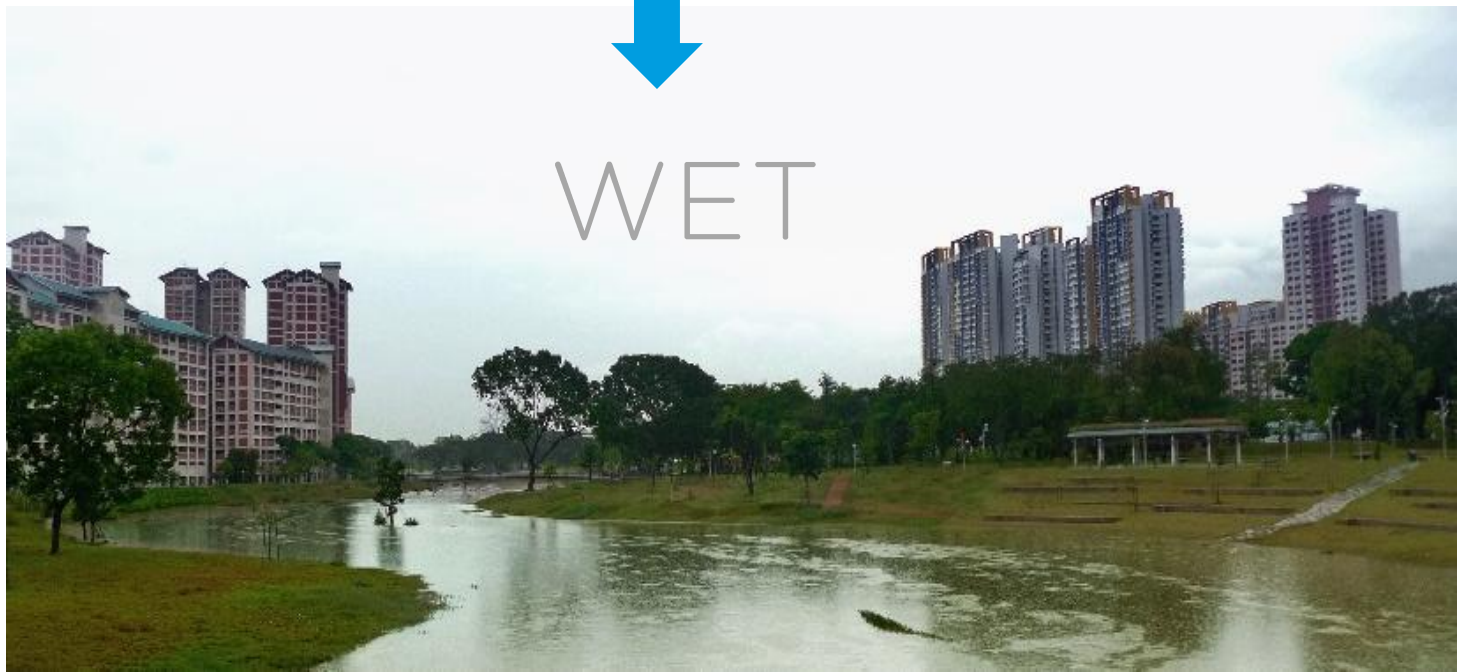
INTEGRATIVE SOLUTION

WATER AS A TREASURE


DRY


WET


DRY


WET

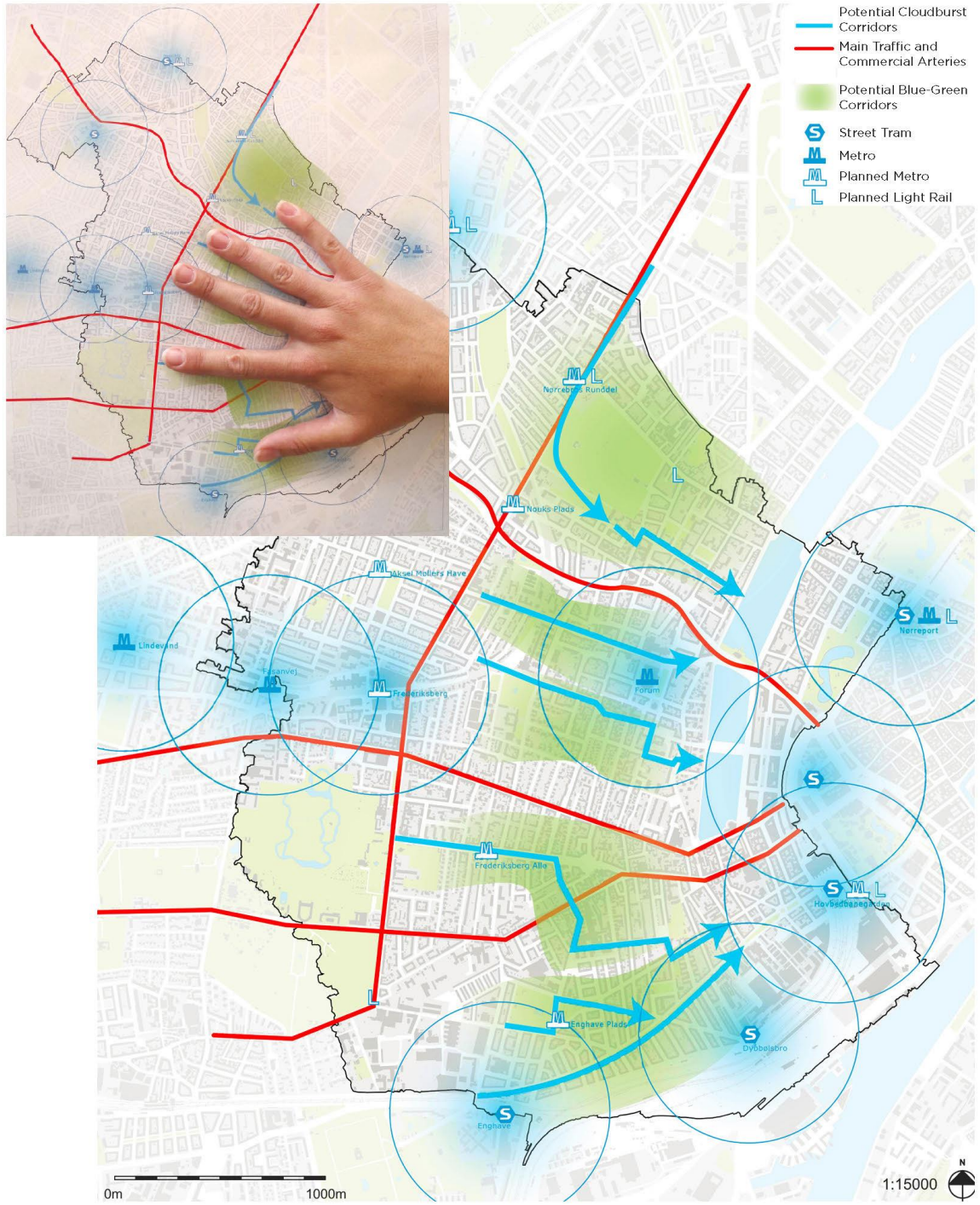
How would nature design this?

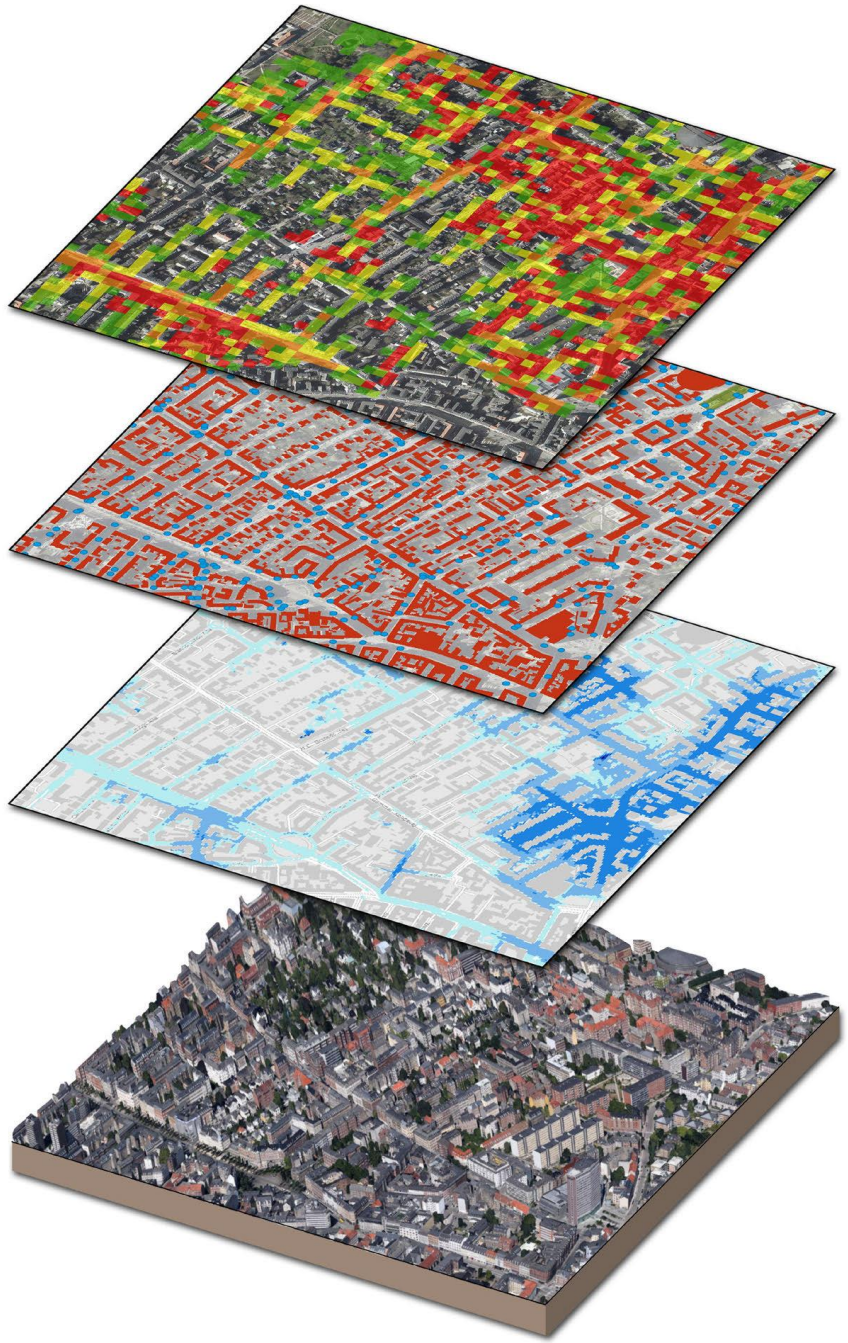
Adding value and positive impacts:
Inspiration for a noise barrier that improves biodiversity, carbon sinks and micro-climate

Pictures: Henning Larsen part of Ramboll

CITY LEVEL

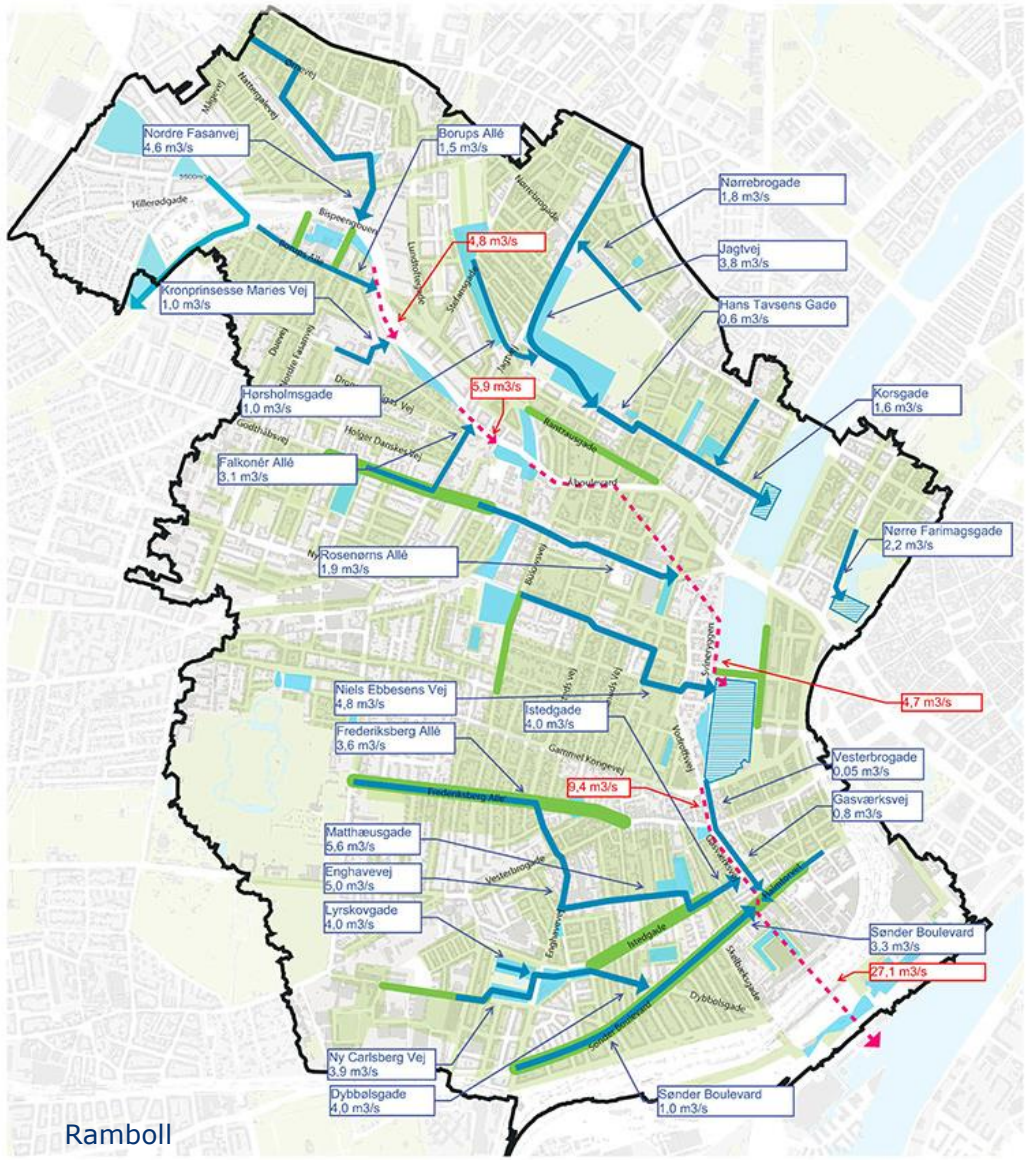
Case Copenhagen Cloudburst Plan Denmark





Detailed site analysis reveals the complex existing situations; identifying areas most at risk to flooding shows the potential sites as catalyst pilot projects (Frederiksberg District shown in isometric visualisation above)

Copenhagen Cloudburst Plan



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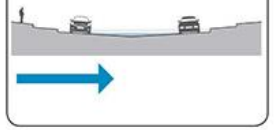
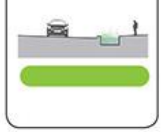
Cloudburst Road



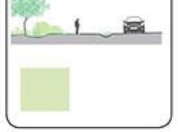
Cloudburst roads are used to channel and direct cloudburst water. These streets can be formed with a unique V-shaped profile and raised kerbs to ensure water will flow in the middle of the road, away from the buildings - contrary to standard engineering practice. Channels and swales can be established along road edges so that water runs in urban rivers or green strips. Cloudburst roads may also be combined with Cloudburst piping below the surface to create tool synergies.

Detention Street



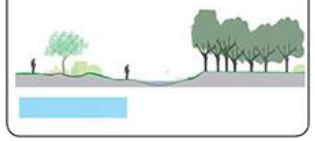
Detention streets are streets that are typically located slightly upstream of vulnerable low-points. In these streets there should be a detention volume established to handle stormwater before reaching the more vulnerable points downstream.

Green Street



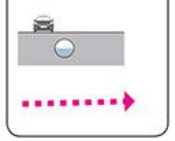
Green streets are proposed as upstream conections to all Cloudburst roads. The green streets should be established with a combination of small-scale channels and stormwater planters or permeable paving. Stormwater should be collected, delayed and then channeled towards the Cloudburst roads.

Central Retention Area



Central retention areas are proposed in the squares and parks where it is possible to delay stormwater, so that Cloudburst roads can be established in smaller dimensions. The central retention elements can be, for example, open depressions in the parkland or lowered seating areas. Alternatively, they can be established as underground storage such as soak-away crates or rain gardens. Central retention elements will typically be placed in connection with adjacent Cloudburst roads.

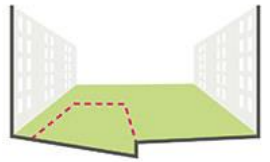
Cloudburst Pipe



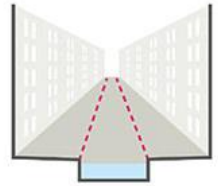
A Cloudburst pipe handles rainwater in the same way as Cloudburst roads. This is placed just below street level to ensure connection to other surface solutions. This solution is used if there is no useable space for aboveground solutions.

CLOUDBURST TOOLBOX

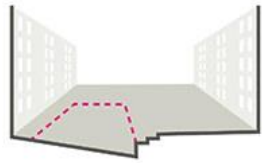
01 Park



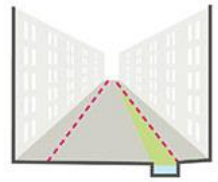
05 Urban Canal



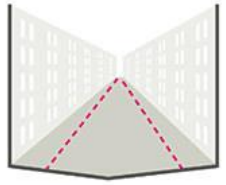
02 Plaza



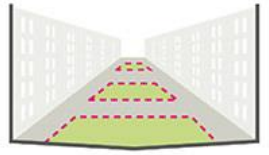
06 Urban Creek



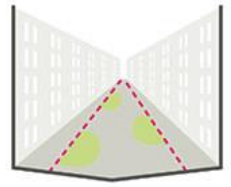
03 Street



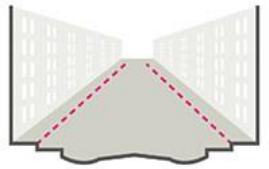
07 Retention Boulevard



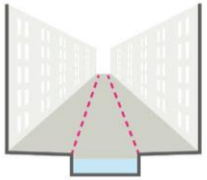
04 Green Street

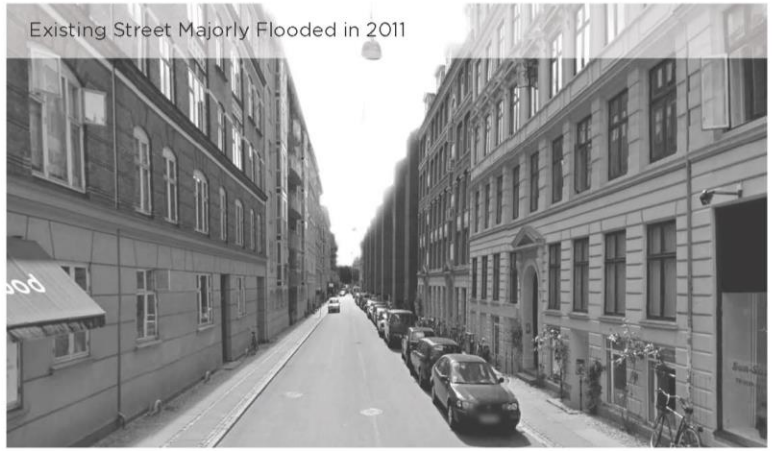


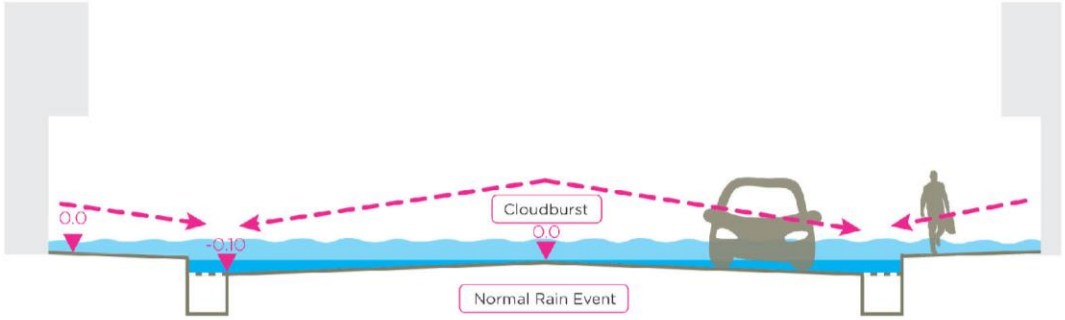
08 Boulevard



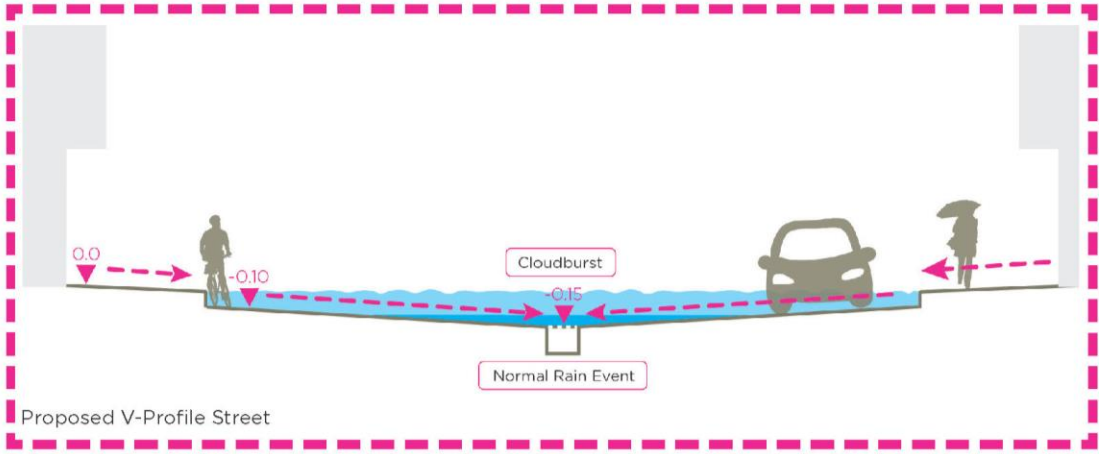
05 Urban Canal



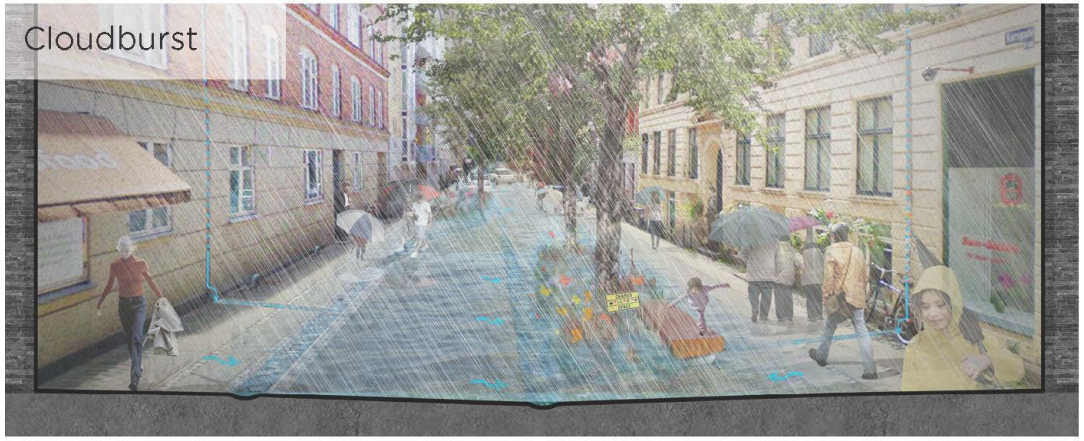




Conventional: Existing Crowned Street



Proposed V-Profile Street

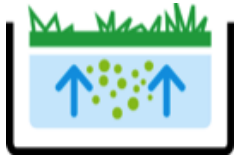


Ran

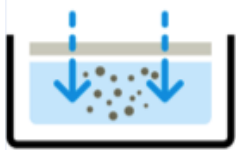
Recommendations to implement Blue-Green Infrastructure

BLUE-GREEN INFRASTRUCTURE TOOLKIT

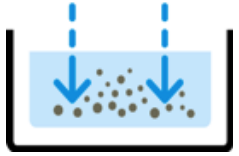
QUALITY CONTROL



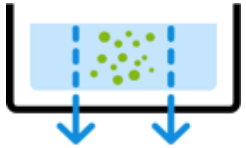
Biological Absorption



Filtration



Sedimentation



Infiltration

Recycle

QUANTITY CONTROL

Evaporation

Conveyance

Detention

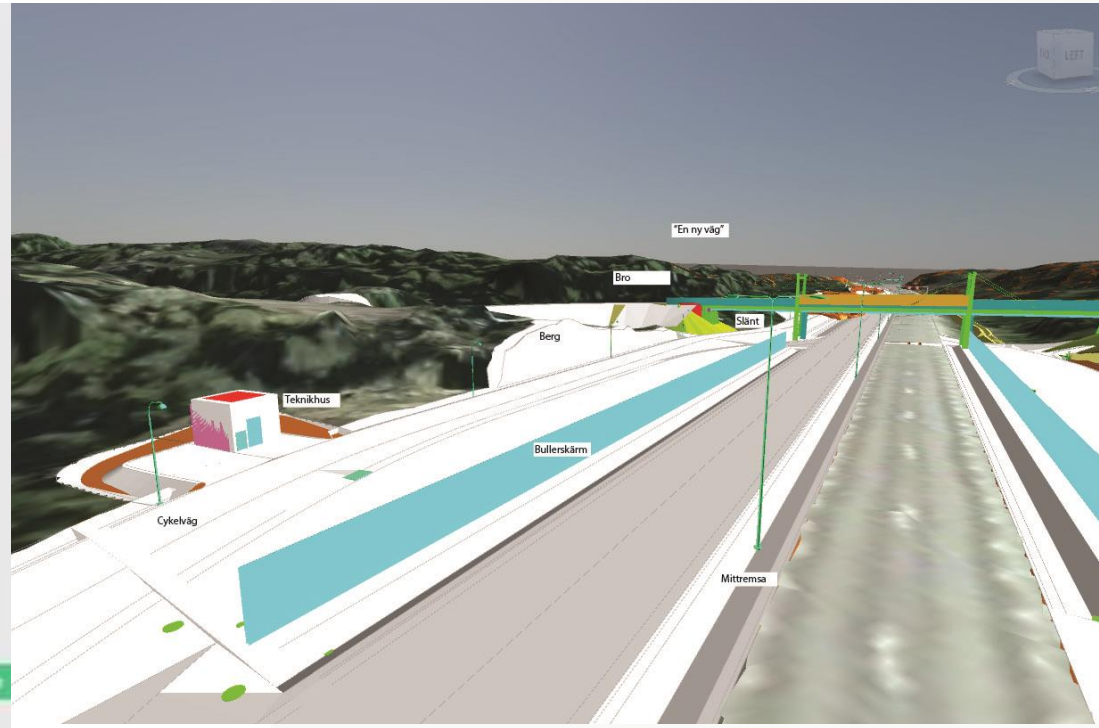
Retention

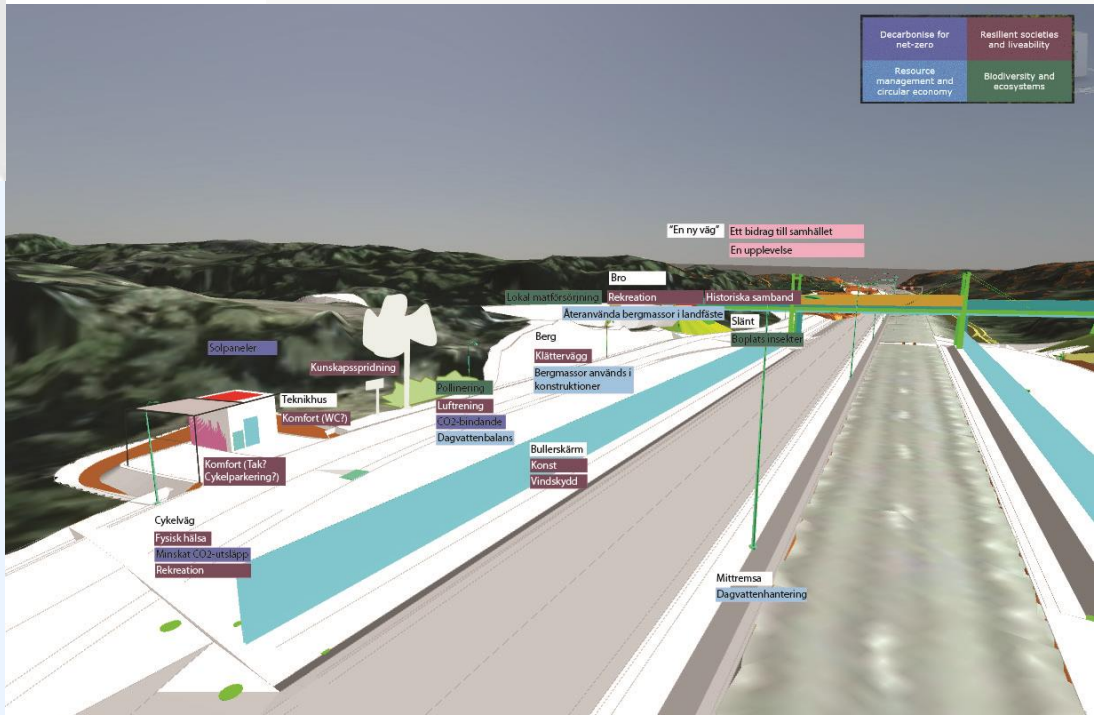
Storage


HUNDE MÅ
IKKE
MEDTAGES

HIGHWAY CASE:

TSK70 highway Sweden





Key actions, identifying the potential:

- Design innovation lead
- Regenerative thinking, designing for multifunction
- Alternative foundation with timber
- Effective road design & maintenance
- Incorporation of blue, green, grey storm water management beds for improved LCC and sustainability
- Innovation Hackathon

Multifunctionality workshop

Ideas identified in various themes and ambition levels

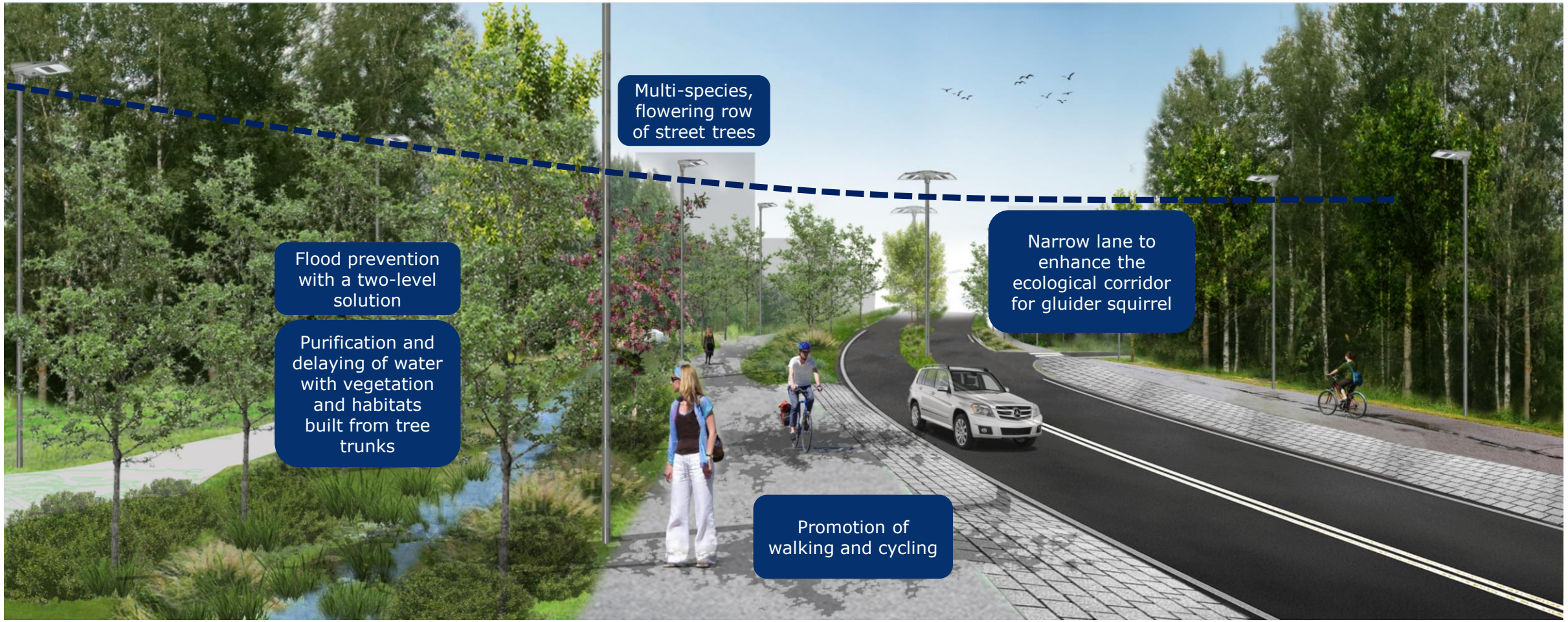
1. Ideas gathered on chosen themes.
2. Ideas put into different levels of sustainability
3. Recognizing the low hanging fruits and visionary ideas

URBAN ROAD CASE

Luhtitie, road design
Vantaa, Finland

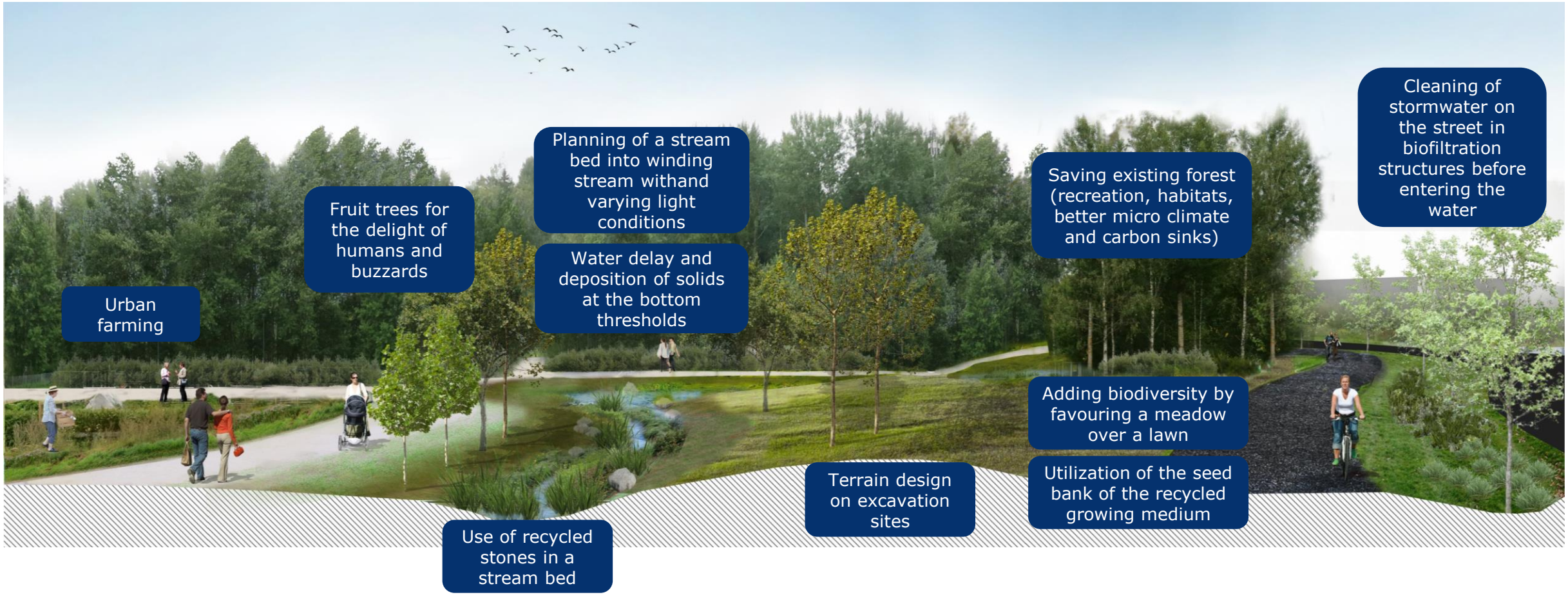
Enhancing sustainability in street design

case Luhtitie Vantaa, Finland



Enhancing sustainability in street design

case Luhtitie Vantaa, Finland



Enhancing sustainability in street design

case Luhtitie Vantaa, Finland

Carbon reductions

Promotion of walking and cycling

Resource smart solutions and climate sinks

Circular economy and resource efficiency

Utilisation of surface and excavation land and their seed bank in growing media

Utilization of surplus stones in Pellaksenoja stream

Exploitation of fallen trees as decayed wood and glider squirrel jumping trees

Liveability and adaptability

Quantitative and qualitative management of stormwater

Promotion of allotment cultivation

Vegetation to improve micro-climate

Biodiversity

Taking nature values into account in every scale

Preserving the habitat of the glider squirrel and securing passageways by, for example, narrowing the street and building jumping trees

Moving a rare solid hammer to a new location under construction

Preservation of decaying moss deposits outside construction

Control of invasive species

Consideration of fish in stream piping

Increasing biodiversity through habitat planning

- Multispecies vegetation
- Favouring a meadow over a lawn
- Addition of decayed wood

LIGH RAIL CASE

Vantaa Light Rail Finland

Actions to promote resource wisdom in Vantaa light rail

Management of wide range of sustainability related actions and impacts is crucial

Street and tramway

- Preparation of type cross sections
- Studying possibilities to use crushed concrete in street structures

Cost and carbon accounting

- Emission intensive structures were recognized in early design phase
- Results were used to decrease embodied carbon
- Final CO_2 values are calculated

Soil & rock material management

- Resource-Tool preparation
- Exploration of the quality of excavation masses, mapping of applications
- Utilization of surplus masses (e.g. level elevation)

Temporary storage and licensing

- Locations, size, need of temporary storage areas (scheduling must be taken into account)
- Explanation of materials to be handled in the temporary storage area and its licensing

Polluted soil

- Map temporary storage and apply needed permits
- Contaminated soil survey
- Acid sulfate soil survey
- Study possibilities to use polluted soil

Topsoil recovery and utilization

- Identification and mapping of top soil (location, quantities, storage, space requirements)
- Development of design principles for the use of recycled substrate
- Survey: Detrimental alien species and their control plan

Circular economy and recycled materials

- Demolition material survey (natural stones, asphalt, concrete)
  - Structures
  - Volumes and material types
- Studying possibilities to use by-products or recycled materials

Green structures

- Investigate the possibilities of using crushed concrete in green and landscape structures
- Identify recyclable materials within the project that can be used in landscape construction

Tram Vibration

- Vibration and structure-borne sound analysis
- Survey of material selections impacts on vibration

Biodiversity

- Crossings and undercuts (securing of species routes)
- Ecological compensation
- Study possibilities to preserve existing vegetation

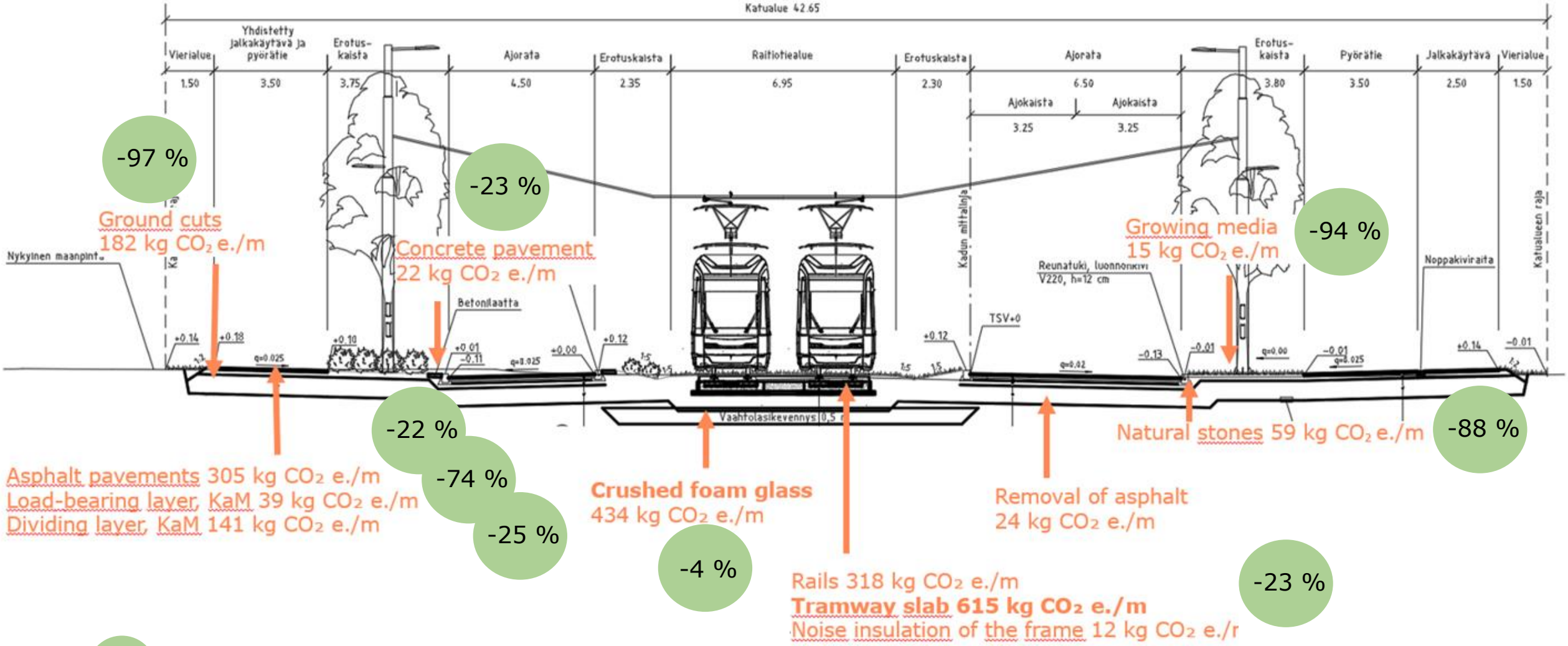
Maintenance

Review of design solution's impacts on maintenance and use phase

Monitoring and communication of results

- Sharing information via communicator specialist
- Report and monitor the outcome

Emissions calculation supporting decision-making



-97 %

Ground cuts
182 kg CO_2 e./m

-23 %

Concrete pavement
22 kg CO_2 e./m

-94 %

Growing media
15 kg CO_2 e./m

-22 %

Asphalt pavements 305 kg CO_2 e./m

-74 %

Load-bearing layer, KaM 39 kg CO_2 e./m

-25 %

Dividing layer, KaM 141 kg CO_2 e./m

-4 %

Crushed foam glass
434 kg CO_2 e./m

Rails 318 kg CO_2 e./m

Tramway slab 615 kg CO_2 e./m

Noise insulation of the frame 12 kg CO_2 e./r

Removal of asphalt
24 kg CO_2 e./m

-23 %

Natural stones 59 kg CO_2 e./m

-88 %

Embodied carbon reduction potential

Case Vantaa Light Rail, Finland

DEVELOPMENT PLAN CASE

Central Oulu development plan 2040

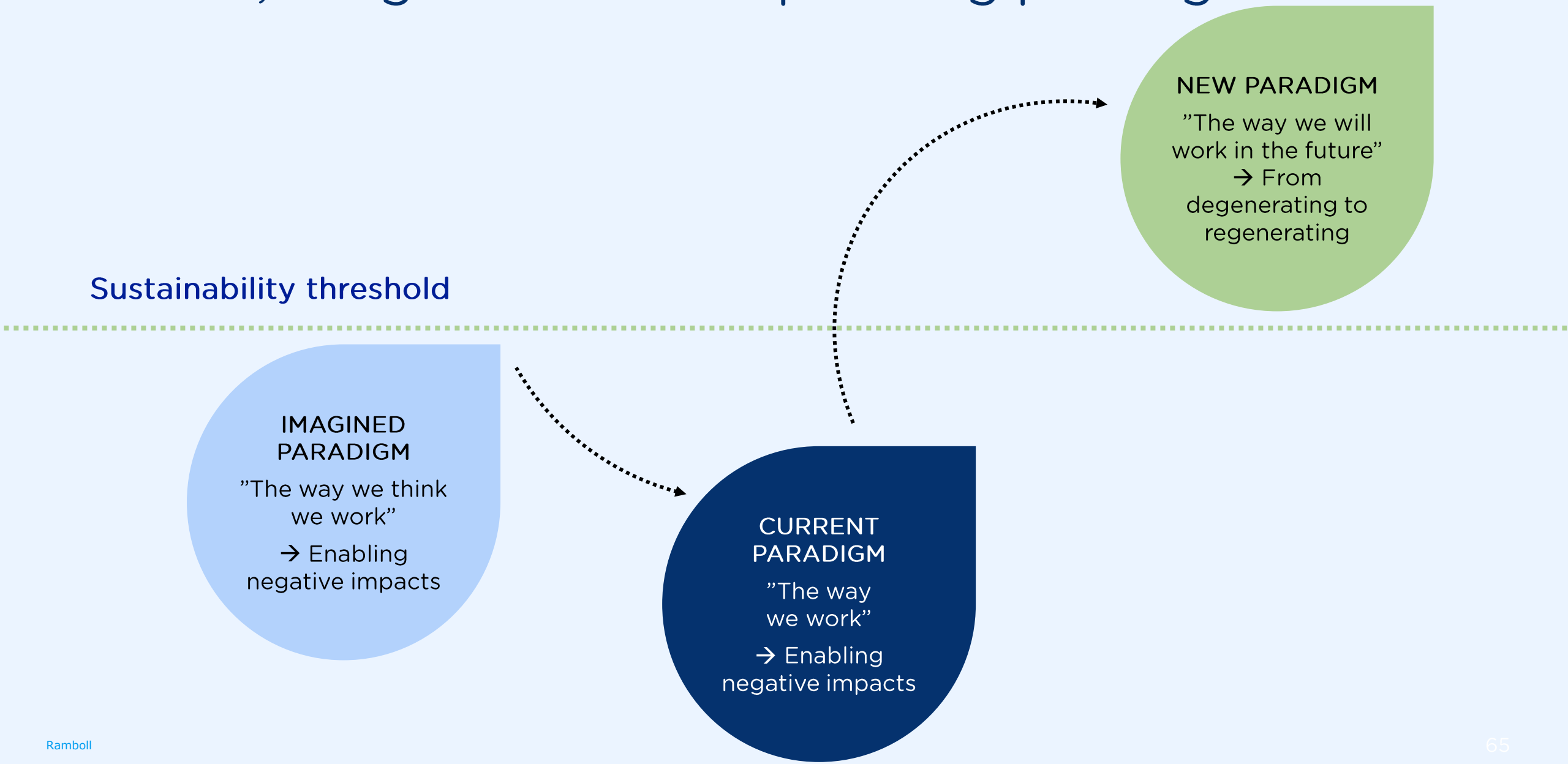
City of Oulu
Implementation: 2024-2025

Keywords:
- Urban planning (master plan)
- Regenerative thinking
- Holistic sustainability
- Futures research
- Co-creation

“Essential perspectives include sustainability goals, the need for systemic change in communities and land use, and the transition from urban planning and activities that destroy the environment to urban planning and operations that extensively renew and regenerate the environment.“

- Client, a quote from the tender inquiry

Current, imagined and new planning paradigm



Regenerative cities

72-hour Transport Challenge 2024, Finland

What will future regenerative neighbourhoods look like, and how will cities be sustainably connected to each other?

4 universities

2 cities

~100 students

++ collaborations

Mindset change

	Building new	→		Renovation, Re-use
	Solution	→		Process
	Answers	→		Questions
1-50 years	Short-term thinking	→	200+ years	Long-term thinking
	Technical systems	→		Living systems

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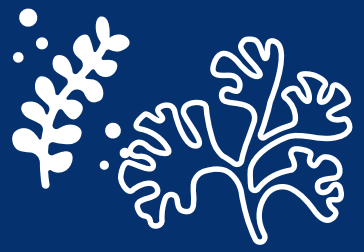
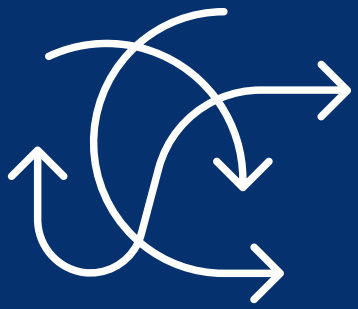
Key take-aways



Nature is your design guidebook.

Co-create with stakeholders – also with other species.

Zoom in, zoom out to see the bigger picture and linkages in the system



Focus on the process – it will create the solutions fit for place.

Thank you!

Elina Kalliala

Global Sustainability Director

Ramboll Transport –
Infrastructure & mobility

M +358 505111866
Elina.kalliala@ramboll.fi

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Bright ideas.
Sustainable change.